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Gynaecology

Ultrasound features of immature ovarian teratoma: Case series and review of literature

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Abstract

The aim of this case series was to characterise immature ovarian teratomas (IOT) using grey-scale and Doppler ultrasonography to increase the detection rate and awareness of these tumours. This has not been achieved to date. This is a multicentre retrospective case series review. Patients with a confirmed histological diagnosis of IOT, from 2006 to 2018 at King's College Hospital and St George's Hospital London, ultrasound scans were retrieved and described according to IOTA criteria. Eight patients were identified in total with a mean age of 26 years old (range 13–35). Presenting symptoms included abdominal mass, pelvic pain and/or amenorrhoea. Half of the patients had a previous mature ovarian teratoma (three ipsilateral, one contralateral). The cysts were large (median 115 mm), fast growing unilateral cysts with a single, peripheral, predominantly solid component arising from the cyst wall. The solid component was hyperechoic with multiple foci of fibrosis and numerous small cysts. The cystic component typically formed less than 75% of the lesion and the cyst fluid was of low-level echogenicty. Subjective assessment of vascularity of the solid part of the tumours varied between scores of 0–2. Tumour markers in this cohort showed a raised serum a-fetoprotein level in 42% of patients. IOT are rare, rapidly growing ovarian cysts that typically have a large predominantly solid, poorly or moderately vascularised component. This component is typically less cystic than the multilocular 'honeycomb' nodules of mucinous borderline tumours and much larger than the small papillary projections seen in serous and sero-mucinous borderline tumours. The hyperechoic sebaceous material that is pathognomonic of dermoid cysts was not a typical feature. The images and features described should facilitate the presumptive preoperative diagnosis in patients who present with ovarian cysts in their twenties, particularly in women with a history of a previous dermoid cyst.

Review of the outcomes of pregnancies of unknown location in a District General Hospital

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Abstract

Pregnancy of unknown location (PUL) is a common diagnostic challenge. Correct management of PUL is crucial to reduce unnecessary intervention as well as to aid the timely detection of ectopic pregnancies. Furthermore, over-surveillance with repeated scans may result in unnecessary anxiety for the woman as well as increased workload for the Early Pregnancy Assessment Clinic (EPAC). The rationale for this review was prompted by an anecdotal observation that the frequency of PUL incidents had increased within our unit, resulting in multiple scans for the woman before a final diagnosis was made. The purpose of this review was to identify any local factors that may influence the management of women with a PUL and standardise the care received by these women. A retrospective data collection was carried out between January and June 2018, reviewing women attending an EPAC with the initial diagnosis of a PUL. The data collected included the diagnosis at

the first scan and all of the subsequent scans and BHCg results if available. The ultrasound results were then grouped into five categories based on their sonographic findings and the final outcomes recorded. One hundred and sixteen women presented to the EPAC, with 49 (42%) diagnosed initially with PUL; of these, 20% were presenting at a gestation of six weeks or less. On average, each woman had 2.3 scans per pregnancy, with three women having four scans. There were two ectopic pregnancies missed in the review period. These cases were evaluated and areas of improvement identified. Local guidelines need to be regularly reviewed and implemented. Teaching sessions need to be facilitated to enable correct interpretation of images and reporting by sonographers and the interpretation of these reports by EPAC nurses and medical staff. A repeat review is planned to monitor changes in practice.

Case report: C-section scar sausage

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Abstract
In the last five years, the author's trust has seen a significant increase in the number of scans performed for complications of lower segment Caesarean section (LSCS) operation scars. These include haematomas, seromas, abscesses, dehiscence and endometiotic deposits. This case study describes several cases of abnormal lesions seen on the anterior myometrium in the region of a previous LSCS scar found in patients complaining of abnormal uterine bleeding and pain. The lesions have ultrasound appearances of soft tissue but have no significant vascularity and are described as 'sausage-shaped'. The sonographers have reported unknown aetiology and therefore questioned the significance of these 'lesions' and have recommended that the patients have further imaging and in some cases referred the patient to a gynaecologist. In all cases, the patients have undergone repeat transvaginal ultrasound scans or magnetic resonance imaging. The lesions appear to have benign features and have been reported as being of no clinical significance, and not the cause of the patients' symptoms. There has been an increase of LSCS scar complications; however, the findings described are incidental, asymptomatic and benign and do not require further imaging or follow-up and do not appear to be the cause of the patient's symptoms. However, the significance in future pregnancies needs further evaluation.

Case report: A presentation of post-menopausal pyometra

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Abstract
Pyometra, the accumulation of pus in the endometrial cavity, is a relatively uncommon gynaecological presentation. It is more common in elderly postmenopausal women and there is an associated risk of a malignant cause. A 73-year-old lady was referred to the emergency department via her GP following an episode of foul smelling vaginal discharge of sufficient quantity to soak through her clothing. The patient is para 10, all vaginal deliveries. Bloods and biochemistry were normal. Speculum examination proved difficult. She was referred for a pelvic ultrasound scan. The trans-abdominal pelvis ultrasound demonstrated a markedly distended endometrial cavity, measuring 11.2 cm × 6.5 cm × 7.3 cm, the content of which was echogenic and motile, highly suggestive of pus. The myometrium appeared thin, most likely due to atrophy and distension, but was otherwise unremarkable. Interrogation with power and colour Doppler demonstrated no vascularity within the uterine cavity and no solid intrauterine masses were identified. Neither ovary was identified but no adnexal masses were seen. The patient declined a transvaginal scan. The patient underwent a hysteroscopy and 400 ml of foul smelling pus was drained from the endometrial cavity. A contrast-enhanced CT of the thorax, abdomen and pelvis was performed post-hysteroscopy which demonstrated a residual collection within the endometrial cavity but was negative for any evidence of malignancy. Pelvic MRI yielded no additional information. Endometrial curettings were sent for histology which showed florid endometritis but no evidence of malignancy. Following a course of antibiotics, the patient proceeded to a total abdominal hysterectomy with bilateral salpingectomy and oophorectomy which on histology demonstrated chronic endometritis but no evidence of malignancy. Trans-abdominal pelvic ultrasound clearly demonstrated the presence and size of the pyometra. CT and MRI helped rule out a malignant cause and pathology confirmed its benign aetiology.

Head and Neck

Case report: Metastatic parotid and thyroid masses from renal cell carcinoma

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Abstract
A 75-year-old female presented to the Head and Neck One Stop Clinic in November 2017 with a palpable right parotid lump and left anterior neck. She had a previous medical history of renal cell carcinoma (RCC) in 2013. There are very few cases in the literature of parotid metastasis from RCC or thyroid metastasis from RCC. This case presents and discusses an even more uncommon finding of thyroid and parotid metastases in the same patient, and possibly but unconfirmed histologically, submandibular gland (SMG) metastasis. Imaging findings and patient management are discussed. The findings included a 25 mm × 16 mm right parotid lesion, which was visible and palpable, with a differential diagnosis given as a pleomorphic adenoma. The thyroid gland was enlarged due to the presence of multiple large nodules, the largest in the left lobe measuring 35 mm × 27 mm. This had U3 features in line with BTA guidelines. There was also a 9 mm hypoechoic lesion in the left SMG gland which was too small to characterise on ultrasound. Contrast-enhanced CT showed a 3 cm, well-defined, strongly enhancing mass superficially within the right parotid gland and a similar enhancing mass within the left submandibular gland measuring approximately 10 mm. There was a benign goitre within the left lobe of thyroid with no significant tracheal compression. Contrast-enhanced MRI of the neck showed a well-defined mass involving the right parotid gland (probable pleomorphic adenoma) and a left thyroid nodule measuring about 3 cm in diameter. Cytology and histology tests revealed the following. An ultrasound guided fine needle aspiration (FNA) of the thyroid was classified as Thy3a. An ultrasound (US) guided FNA of the parotid gland showed a possible primary salivary gland malignancy. An ultrasound guided FNA of an SMG lesion was non-diagnostic. MDT recommended parotid and thyroid lesion US guided biopsy. A US guided 18 G core biopsy of the right parotid lesion and left thyroid nodule revealed profiles consistent with metastatic RCC. This is a rare presentation of renal cell carcinoma metastases in the head and neck.

Professional Issues

Preceptorship in practice

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Abstract
In recent years, we have seen the advent of several different educational entry routes into the sonography profession, all designed to reduce the national shortage of sonographers. How do we ensure that these newly qualified sonographers are supported into practice, to become confident, autonomous and competent practitioners working within a defined scope of practice? Preceptorship is a widely acknowledged and accepted developmental process in nursing and midwifery, with national and regional frameworks to support the transition of newly qualified staff into their first professional post and beyond. Historically, allied health professionals have not had the same access to these programmes with the concept of preceptorship varying across individual departments, from some with very structured and defined levels of support, including, education, mentorship, clinical supervision leading to audit of scanning and reporting and a final sign off of competence, through to others operating on a 'sink or swim' philosophy. Nursing has a high attrition rate in the early post-registration period, largely cited as being due to burnt out. A contributing factor is the disparity between the individual's expectations of the role and the demands of the post; this leads to stress and ultimately burnt out. With all of the work done by professional organisations to increase the sonography workforce and training capacity, it is vital that we do not lose staff in this way. We must ensure that newly qualified sonographers are supported into practice and that they are safe, confident, caring practitioners who can provide a high quality safe service to patients. This talk explores the concept and purpose of preceptorship, including types of activities and models of preceptorship, showing the benefits of this important period in supporting the newly qualified workforce into independent practice. It examines the benefits of preceptorship to the workforce, the service and the service user whilst acknowledging some of the challenges of supporting preceptorship in the busy workplace.

Vascular

A retrospective analysis of the growth rate of common iliac artery aneurysms

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Abstract
The objective of this analysis was to determine the prevalence and growth rate of common iliac artery aneurysms (CIAA) in patients attending a regional vascular laboratory. An audit of clinical reports of patients attending a regional vascular laboratory to undergo an aorto-iliac duplex scan (USS) was undertaken retrospectively. Expansion rate of aneurysms was studied in patients who had >2 USS scans; data were recorded at 6 and/or 12 monthly intervals up to five years. Patient age, initial CIAA diameter, bilateral/unilateral CIAA and coinciding aortic diameter were recorded to determine if these specific risk factors were associated with CIAA growth rates. Pearson's correlation coefficient was used to determine the strength of association between variables. Of 1060 patient records, 995 were suitable for review; 21.6% (215/995) of patients had a CIAA. Isolated CIAA accounted for 17.2% (37/215). Mean CIAA growth was 1.5 mm/year. There was a strong correlation between CIAA diameter vs. time from diagnosis ($R = 0.820$; $p = 0.004$). Data showed that the smaller the initial CIAA diameter (15–20 mm), the more rapid the growth rate ($R = 0.9145$; $p = 0.001$). An initial CIAA diameter greater than 30 mm was not significantly correlated with growth rate. No impact of unilateral/bilateral CIAA on growth rate was identified. In the presence of an AAA measuring >50 mm ($R = 0.305$; $p = >0.05$) CIAA growth is less predictable. AAA diameter < 50 mm did not correlate significantly with CIAA growth rate ($p = >0.05$). These data will enable development of a CIAA surveillance protocol.

Outcomes after deep vein thrombosis: Resolution, recurrence, reflux and PTS

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Abstract
Evidence indicates that there is variability in thrombus resolution and residual venous function after deep vein thrombosis (DVT). Whether this is important for longer term outcomes is unclear. Some patients may recover fully after DVT whilst others are left with chronic symptoms grouped under the umbrella term post-thrombotic syndrome (PTS). The objective of this study was to examine the natural history and response to the treatment of DVT and assess associations between baseline or follow-up characteristics and the longer term outcomes: resolution, recurrence, venous incompetence and PTS. A total of 171 consecutive participants with a first episode of acute DVT were followed up at defined intervals for up to two years. Ultrasound was used to examine changes in thrombus and venous function. PTS was assessed using the Villalta score. Possible predictors of outcome after DVT were analysed using multivariate logistic regression. DVT remained unresolved when prescribed anticoagulation treatment ceased in 34% of cases and 27% remained unresolved at two years post-diagnosis. Recurrent DVT during follow-up was detected in 15%, new venous incompetence developed in 28% and PTS developed in 30%. Following adjustment for confounding, distal DVT and cases with lower thrombus burden were significantly more likely to resolve. The development of venous incompetence was associated with proximal DVT and treatment with heparin and warfarin rather than Rivaroxaban. Women were more likely to develop PTS than men. PTS was also associated with being overweight, residual DVT, not using compression stockings, superficial venous incompetence and deep venous incompetence when combined with superficial incompetence. No significant associations were found with treatment duration, smoking, hypertension, provocation status, pre-existing incompetence, superficial thrombophlebitis, symptoms duration, thrombus evolution pattern or recurrence. This study provides information that could potentially inform better patient information and lifestyle advice, risk stratification for PTS and more tailored treatment for DVT which could be assessed through future research.

BMUS Young Investigator 2018

Nonlinear effects in modern diagnostic ultrasound imaging equipment with high working frequencies

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Abstract

Diagnostic ultrasonic imaging systems with operating frequencies in excess of 30 MHz are emerging for clinical use to improve the image resolution. Until recently, limitations in hydrophone technology prevented the study of nonlinear effects in such high-frequency systems. Nonlinear effects are of great importance since they can increase the amount of heat deposited locally into biological tissue and thereby raise some serious safety concerns. The objective of this paper is to evaluate the level of nonlinearity, which consists of nonlinear wave propagation and nonlinear behaviour of the transducer, and the associated consequences for modern equipment with high working frequency. To this end, a very broad band hydrophone was used to capture the pressure field of a commercial linear array imaging system working at 50 MHz, in the range of 1.2 to 8 MPa peak-to-peak pressure at the focal point in water. Strong higher order harmonics were measured even at the lower end of this pressure range. Under high-pressure conditions, the amplitude of the second harmonic was only 1.5 dB smaller than that of the fundamental component; calculations indicate that the rate of heat deposition associated with the second harmonic is approximately 2.5 times that of the fundamental component. This implies that nonlinear effects (nonlinear wave propagation and nonlinear behaviour of the transducer) cannot be ignored for high-frequency systems in terms of thermal bio-effects. In addition, an amplitude-dependent down-shift in the overall spectrum of the fundamental component is introduced as another consequence of nonlinearity for high-frequency systems. The down-shift is due to the frequency dependence of the nonlinear effects which can lead to a noticeable decrease in lateral imaging resolution. A significant amount of down-shift (up to 35% of the central frequency of the fundamental component) was observed for the investigated 50 MHz system.

The quality of ultrasound training for first year radiology trainees and the impact on the ultrasound department

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Abstract

First year radiology trainees (ST1) generally enter training with no ultrasound experience. They need to be competent in on-call scans to answer clinical questions by the end of that same year. We looked at the quality of training for ST1s across the Northwest deanery and the impact on the US departments facilitating this training. A questionnaire was emailed to all ST1s in the Northwest deanery. A customised questionnaire was also conducted with ultrasound department managers in the Northwest. The questionnaires included questions on number of lists, number of patients per list, background of trainers, measures to facilitate training and rating of the quality of training on a scale of 1–5, as well as free text comments. There were responses from 76% of ST1s, with an average of 1.2 lists per week, 64% having six or more patients per list. Different sonographers led in 32% of the sessions, 32% were consultant radiologist led, 18% were with both a consultant and a different sonographer and one had no list. The average rating of ultrasound training was 3.7. Of the trainees, 36% had both increased time slots and reduced patient lists, whilst 46% had no provisions to facilitate training. Comments included: a disparity between sonographer training and ST1 training, cancellation of lists and lost scanning time due to patient and trainers' cancellations and absences. The ultrasound manager's questionnaire revealed that departments had 1–3 ST1s, and all had trainee sonographers. Average rating of ST1s training was 3.5, whilst sonography training rating was 4.5. Comments discussed the need for dedicated lists, but the inability to provide them due to the impact upon backlogs. Ultrasound training for ST1s is variable despite time pressure to become competent. Staff shortage and backlog pressures impact upon training. Dedicated lists with a dedicated ultrasound tutor responsible for trainees learning would improve US training.

UltrasoundEd

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Abstract

Social media has become an integral part of daily life with 38 million users in the UK alone and the average user being logged-in for 135 minutes per day. Social media has become increasingly used to disseminate learning in a variety of fields but particularly in medicine. A number of Instagram accounts are now solely dedicated to education in Radiology. The aim of this study was to assess the current use of Instagram in disseminating ultrasound education. An Instagram

search using the hashtags: #Ultrasound and #Radiology were conducted and the content of the posts classified into social and academic. The results were then compared. There are 461,884 #Ultrasound posts compared with 243,011 #Radiology posts. From the first 30 #Ultrasound posts retrieved, 3 were educational and 27 were social. The social posts predominantly relate to announcements of pregnancy. In comparison 21/30 #Radiology posts are educational while 9 were classified as social. There are a number of educational radiology and ultrasound accounts on Instagram. While the educational radiology posts are relatively easy to find, those for ultrasound are buried within a sea of social posts. We propose the adoption of the hashtag #UltrasoundEd to separate educational ultrasound posts and make them easier to identify. This is in order to allow the rapid free dissemination of ultrasound education. Social media can be an excellent tool for education. Instagram is an ideal platform for this as it is image based. The use of a standardised hashtag (#UltrasoundEd) for ultrasound education will help easily identify relevant educational posts.

Vastus lateralis' stiffness: A supersonic shear wave elastography study

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Abstract
Supersonic shear image (SSI) is an ultrasound elastography method that offers a direct quantitative measure of tissue stiffness based on the velocity of shear waves. The potential of this technique is enormous and has enabled researchers in many fields. The purpose of this study was to assess changes in Vastus Lateralis's shear modulus with knee position and after a session of maximal isometric and isokinetic Concentric and Eccentric contraction and to analyse the relationship between Vastus Lateralis's shear elasticity and submaximal knee extension torque with SSI. Sixteen subjects were submitted to acute changes in Vastus Lateralis's stiffness associated with passive stretching, performance of short but intense contractile activity, and muscle isometric contractions that were investigated by means of SSI. The results demonstrated an acute increase of around 10% in Vastus Lateralis's shear modulus as a result of performing maximal isometric, concentric, and eccentric contractions. The shear modulus of the Vastus Lateralis also increased when the knee moved. Finally, a linear relationship between the shear modulus and the level of isometric muscle contraction was observed. SSI proved to be a good method to investigate muscle mechanical property changes associated with muscle function. These results emphasise an objective and quantifiable muscle ultrasound evaluation for studying muscle adaptation and function, in general.

The Stacked-Ellipse algorithm: A novel 3D uterine segmentation tool for enabling adaptive radiotherapy for cervical cancer

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Abstract
The purpose of this work was to enable adaptive radiotherapy (RT) for cervical cancer whereby the beam aperture conforms to the target. It is essential to know the shape and position of the uterus with respect to the treatment room isocentre. Although it is possible to visualise the uterus with 3D transabdominal ultrasound (3DTAUS), there is an unmet clinical need of fast 3D uterine segmentation for the purpose of US-guided RT. The Stacked-Ellipse (SE) algorithm was developed using a training set of 5 patients to semi-automatically segment the uterus on 3DTAUS, and evaluated on an independent cohort of 10 patients. The uterus of 15 patients was scanned with 3D US (5 MHz centre frequency) using the Clarity® System (Elekta Ltd) at multiple time points during treatment, resulting in a dataset of 49 images. The uterus was manually contoured on each 3DTAUS. Five uterine contours from the Herlev cohort comprised the training set for parameterising the uterus as a series of stacked ellipses. The SE-algorithm was validated on the remaining 44 US images in the RMH cohort using the manual contours as the gold-standard. The SE-algorithm uses a manually initialised slice in the sagittal plane to provide a series of 2D elliptical initialisation contours in semi-axial planes along the length of the uterus. Each 2D elliptical initialisation contour is deformed according to image features in the semi-axial planes of the US images such that it conforms to the uterine boundary, regularised to smooth the contour and

correct for outliers, and projected into 3D. The median (interquartile range (IQR)) Dice Similarity Coefficient and mean-surface-to-surface-distance between the SE-algorithm and gold-standard was 0.80 (0.03) and 3.3 (0.2) mm, respectively, which is within the range of reported interobserver contouring variability. The SE-algorithm could be implemented in adaptive RT to precisely segment the uterus on 3DTAUS.

Student Education Session

Undergraduate student clinical experience

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Abstract
The introduction of new educational routes into sonography has provided new challenges to clinical teaching methods. Clinical departments are under increasing pressure with growing patient volumes, staff shortages and now longer training programmes. It is essential that both students and clinical departments are supported throughout the training period. This is an account of my experience as an undergraduate sonography student across multiple west midlands NHS trusts, discussing what has worked well and the challenges faced. Areas of comment will include supervision, hands-on scanning, interesting cases, report writing and social wellbeing.

Qualified healthcare practitioner promoted to student: An interpretive phenomenological analysis of the impact of job characteristics on motivation for the student sonographer

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Abstract
A current national shortage of sonographers is causing severe service delivery issues, and figures show that the problem is getting worse. Ultrasound imaging is a frontline diagnostic tool in the detection of many pathologies including cancer. This study proposes, with the application of psychological theory of work motivations, to explore the lived experiences of student sonographers entering the post from a radiography background. Since Kramer's seminal paper in 1974, which highlighted 'transition shock', there has been a huge body of work produced by the nursing field exploring and analysing the transition from student nurse to qualified practitioner. There is yet to be any research done in the allied health professions field, specifically concerning the unique pathway from transitioning from a qualified radiographer to student sonographer. Hackman and Oldham's job characteristic model, building on Herzberg's motivation-hygiene theory, states that there are five job characteristics that are essential to engage higher order needs for employees: autonomy; task identity; task significance; task variety and feedback. A qualitative interpretive phenomenological analysis methodology using semi-structured, open ended interview schedules was developed. Four participants, enrolled on a CASE approved training course in the UK, aged 24–30 were recruited as a purposive sample. Data were transcribed verbatim. The validity of this study was demonstrated against Yardley's four broad principles: sensitivity to context; commitment and rigour; transparency and coherence; impact and importance. Interpretative phenomenological analysis demonstrated three master themes in the data: 'I want to be the expert' – evolving professional identity; 'being bottom of the pile' – adjusting to a new position; 'It's not remotely standardised' – differing practices and training. The findings suggest that themes in the lived experience of participants are congruent with the five factors detailed in the theoretical framework. These links may offer insight for sonography departments on the broader motivational factors impacting current sonography students.

Ultrasound guided procedures: What are the barriers surrounding interventional practice for sonographers?

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Abstract
The main aim of this study is to identify the barriers of ultrasound-guided interventional practice for sonographers in England. The radiographer/sonographer role development has been driven by a shortage of radiologists and the need to maintain an effective diagnostic service. The demand for radiology examinations has risen over recent years due to the increasing population. The participants involved in this study were qualified sonographers in England. Between 6 February 2018 and 13 March 2018, a self-selecting questionnaire was available online which consisted of 32 closed-ended questions

and 3 open-ended questions. Conventional descriptive statistics were presented in the form of frequency histograms, and qualitative responses were then amalgamated, split and analysed thematically. A total of 202 responses were obtained from the online questionnaire. The number one ranked barrier for ultrasound-guided interventional practice was staff shortages, with many expressing that radiologists are a large barrier. This study has found 29% of those who perform interventions will retire within five years. It was identified that average ages of those performing intervention were between 44 and 55. There is a significant difference between regions in seeking and performing intervention ($p = 0.02$). Various key trends relating to the barriers were identified, which include personal preference, salary, education, training, costs, negative perceptions of other professionals, auditing, protocols, CPO and medico-legal issues. Other barriers such as prescribing issues, part-time working, training waiting lists and no demand have also been highlighted by the study. Participants who undertake ultrasound-guided intervention were positive about teaching others. Generalisation of these results is limited due to the number of responses. This research has uncovered the attitudes of those who perform interventions. These findings should be acted upon by introducing a change in practice, a larger-scale study including the whole of the UK would be useful.

Case report: Neonatal neurosonograhy case study of subdural collection

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Abstract
Baby X was seven months old at the time of the cranial ultrasound and had been an 'in-patient' at a specialist paediatric hospital since birth. During pregnancy, mum was offered a termination as the foetus was diagnosed with osteogenesis imperfecta (OI) type 2 and had already sustained numerous fractures while in utero. The patient's survival until today makes this a rare case. Osteogenesis imperfecta is an inherited rare collagenous disease characterised by different degrees of low bone mass and an increased susceptibility to fractures and bone deformities. OI type 2 is lethal in the perinatal period and in the most severe form, patients are at a high risk of dying due to lung hypoplasia. Neurological complications of children with OI involve chronic subdural collections/haematomas, acute intracranial haematomas and hydrocephalus; this is due to permanent friction between the multiple bone fragments of the skull and vascular fragility. In this case study, the role of ultrasound, as a first line investigation in a case of subdural collection, is evaluated. The head circumference has increased and due to the complex background, a cranial ultrasound scan was requested. The diagnosis was a subdural collection on ultrasound; the patient underwent a CT scan post-US to further evaluate this; however, CT did not add any more information. Neonatal neuroimaging sonography is a very useful initial screening modality for evaluating the neonatal brain, especially in premature babies and babies that have multiple comorbidities and restrictions with imaging. The recent advances in technology, appropriate training and rigorous scanning technique have shown that neonatal neurosonography can be diagnostically accurate and useful as an initial modality for clinical management. Added to this, ultrasound is cheaper than cross-sectional modalities, does not require sedation and there is no ionisation radiation involved.

Case report: Deep vein thrombosis – Always look at the bigger picture

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Abstract
Deep vein thrombosis (DVT) is a frequent medical condition, which can become fatal if a patient develops a pulmonary embolism (PE). This case is of a 57-year-old lady who presented to the emergency department complaining of pain and swelling of her left leg. The patient also had associated shortness of breath and abnormal menstrual bleeding with no associated cause or explanation. The ultrasound examination incorporated a B-mode and colour Doppler assessment of the left leg veins. The external iliac vein, common femoral vein, femoral vein and superficial veins were all patent, compressible and showed augmented flow. The distal popliteal and peroneal veins did not compress and an echogenic area with minimal blood flow was seen within the distal peroneal vein. This echogenic matter indicated a DVT of the distal veins when compression technique was applied. The patient then proceeded to have a transabdominal and transvaginal ultrasound to investigate the abnormal bleeding. The transvaginal ultrasound on both B-mode and power Doppler indicated a cervical lesion. Following the ultrasound examination, the patient became

increasingly unwell and a computed tomography examination was performed. This concluded that the patient had a PE and anticoagulant medication was administered. The patient's respiratory symptoms subsided following this. A pelvic magnetic resonance imaging examination was performed confirming the presence of a malignant cervical mass and the patient was scheduled for surgical removal of the lesion. This case study demonstrates an unusual outcome following ultrasound evaluation of lower limb DVT and the associated cause. Ultrasound played an essential role in the diagnosis of a calf DVT. As no other risk factors for DVT were present, the abnormal menstrual bleeding needed to be rapidly investigated and the cervical mass found on the pelvic ultrasound provided a rapid diagnosis and aided patient management.

Case report: Pyogenic flexor tenosynovitis as a result of a foreign body and the role of ultrasound

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Abstract

Boy X was referred from his GP to the plastic hand surgeons at a specialist children's hospital. The history given verbally from the patient was that post-trauma, his right index finger had been swollen and tender for nearly two months. He visited his local hospital where he had plain radiographs the same day as the trauma, but as no evidence of a foreign body was seen, he was discharged from the hospital and visited his GP a week later as the swelling and pain continued. The GP referred the patient to hand surgeons at a specialist paediatric hospital for an expert opinion. 'Boy X' was seen in the hand clinic where the plastic surgeon felt that an ultrasound scan would be a good first line of investigation followed by a magnetic resonance imaging (MRI) scan to rule out the unknown aetiology of the right index finger pain and swelling. The radiology department was able to offer the ultrasound scan immediately following the outpatient appointment on the same day. The ultrasound scan showed a 3 mm foreign body within the tendon sheath of the flexor tendon with evidence of tenosynovitis. 'Boy X' felt his symptoms began after an incident in which he fell into a rose/thorn bush. The patient then went for an MRI scan two days later where the foreign body was not seen. Ultrasound is a proven unique modality in the detection and localisation of foreign bodies as well as in diagnoses of associated complications, including pyogenic flexor tenosynovitis as in this case. It is quicker and cheaper than any other imaging modality, non-invasive with no known side effects and it is easily repeatable.

Metastatic endometrial carcinosarcoma

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Abstract

Endometrial carcinoma is one of the most invasive malignancies of the female reproductive system. Statistics from Cancer Research (2015) state that uterine malignancy is the fourth most common cancer in females. Approximately 9300 new cases of uterine cancer were diagnosed in the United Kingdom in 2014, with the majority occurring in the endometrium. Endometrial carcinosarcoma has an increased tendency to metastasise early, with the liver being reported as an atypical metastatic site. A nulliparous 64-year-old female presented to the one stop post-menopausal bleeding clinic following recurrent episodes of vaginal bleeding. The patient declined transvaginal ultrasound; therefore, an endometrial thickness of 5 mm was obtained transabdominally, prompting further investigation. Hysteroscopy examination revealed the presence of a $30 \times 12 \times 7$ mm endometrial polyp, which pathology results concluded to be comprised of carcinosarcoma. An abdominal and pelvic Computed Tomography scan revealed no further presence of disease. The patient underwent an abdominal hysterectomy, bilateral oophorectomy, omentectomy and removal of the para-aortic and pelvic lymph nodes. A follow-up appointment was arranged within six months' time. Five months after initial diagnosis, the patient presented to clinic with fatigue and right-sided abdominal pain. An ultrasound scan revealed a 12 cm heterogeneous mass within the right lobe of the liver. A pathological specimen concluded the mass was a metastatic component of carcinosarcoma. The patient received palliative chemotherapy, but unfortunately passed away five months after presenting with right upper quadrant pain. Following recommendations from Nice Guidelines (2015) regarding post-menopausal bleeding, in which an urgent appointment is arranged within two weeks, one stop clinics ensure diagnostic tests and interventions are carried out in a timely manner. Further cross-sectional imaging is paramount following a diagnosis of endometrial

carcinoma, in order to assess the extent of disease and construct treatment plans.

Day 2 Wednesday 5 December

General Medical

Case report: Ultrasound diagnosis of possible scrotal filariasis – Mobile mega sperm a differential

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Abstract
Filariasis (lymphatic filariasis) is primarily caused by a bite to the skin by an infected mosquito, which allows the invasion of filarial nematodes (roundworms) transferring themselves to the lymphatic system, where they nest and multiply. Research has shown that about 120 million people are currently infected, of which 65% are in the Southeast Asia and 30% in Africa. This disease has demonstrated a life span of about 15 years and has been found to cause swelling of the limbs and male genitalia which results in both physical and social disabilities. Although there is low prevalence of this disease in Europe, it is not uncommon for people who travel to endemic regions, to contract this disease. Therefore, there is a need to bear this in mind while clerking patients during scan. Ultrasound appearances demonstrate bulky, dilated and ectatic lymphatic channels of the epididymis with associated mobile, echogenic foci (live filarial worms) representing the typical 'filarial dance sign', exhibiting 'to and fro' movements in an appropriate clinical context. However, there is a fine line between the sonographic appearance of the filarial dance sign and post-vasectomy entrapped mobile mega sperm cells. Therefore, with high prevalence of vasectomy in the UK (21% of men of reproductive age compared to the rest of the world) an accurate patient clinical history is vital in distinguishing between the two, ensuring exclusion and paving the way to explore other possible differentials in such cases. The case to be presented describes the differential diagnosis of mobile echogenic foci along the right epididymal body over the region of maximum tenderness with the patient's long travel history to parts of India and Kenya.

The use of ultrasound to support palliative care in a hospice setting

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Abstract
This study is a retrospective audit of 341 scans carried out by the author (an experienced sonographer) over a five-year period in an adult hospice. The World Health Organisation describes palliative care as 'an approach that improves the quality of life of patients and their families facing the problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual'. Ultrasound imaging is a valuable resource that has been widely used in hospitals for many years. Its usage has been to slow to develop in hospices despite improvements to the cost of machines and their accessibility. It can help clinicians make what are often difficult management decisions at a crucial point in a patient's life. This talk presents a review of the experience of establishing the provision of an ultrasound scanning service in an adult hospice setting. Over the course of five years, 341 scans were carried out on 305 patients, with an age range of 25 to 96. Indications for scans included suspected urinary retention, DVT, and assessment of abdominal ascites or pleural fluid. A wide range of pathologies were found, from disease progression to gallstones accounting for pain. The author offers practical suggestions for scanning in these challenging but rewarding circumstances. The author has been able to demonstrate that a hospice-based ultrasound service is achievable, effective and safe. Clinicians value the greater certainty available with the use of sonography when signs and symptoms are subtle or complex, while patients appreciate not having to travel for imaging.

The multiparametric sonographer

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Abstract
Sonographer role development has been well established within the local ultrasound service for many years. The year 2001 saw the training of the first sonographer within this Trust to undertake transrectal ultrasound-guided prostate biopsy procedures

(TRUS). The service has expanded and there is now a well-established team of six sonographers performing TRUS. Changes in prostate cancer pathways, coupled with cancer targets, have led to increased pressure to innovate and improve the service provided in terms of turnaround times, reduced infection rates and increased diagnostic biopsy yield. To this end, fusion guided TRUS (fTRUS) was developed in 2015 to aid targeting specific lesions identified on multiparametric MRI (mMRI). This fTRUS service has been developed, and is now provided, predominantly by two of the TRUS sonographers. Demand for prostate imaging and biopsy has risen recently in light of increased publicity due to high-profile celebrities being diagnosed with prostate cancer. In addition, there is a move towards pre-biopsy MRI given the benefits of targeted biopsy. These changes have resulted in increased demand for radiologist skills at a time when there are significant recruitment issues and pressures from other service areas. Given that fTRUS requires an understanding and interpretation of mMRI to ensure the correct area is targeted during the biopsy procedure, the sonographers providing this local service began to develop such skills. A solution for increasing fTRUS and mMRI demand has been to formalise the sonographer's skill development into an in-house mMRI reporting training programme. Using radiologists' reports as the gold standard, the sonographer reporting skills have been assessed. Integrating prostate MRI reporting by sonographers into practice has demonstrable benefits to patient care and contributes to the delivery of a sustainable, safe and timely pathway. The role and benefits of the multiparametric sonographer are described in this presentation.

Early post-operative ultrasound for renal transplant: What not to miss

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Abstract
Ultrasound (US) is the preferred imaging modality for evaluation of renal transplants in the immediate post-operative period and long-term follow-up. This is namely due to its accessibility, inexpensive and non-invasive qualities. Furthermore, patients can remain monitored on the hospital ward with the scanning performed portably if necessary. Upwards of 3300 renal transplants were performed in the UK in the last financial year, 1009 living, 1404 donation after brain death (DBD) and 934 donation after circulatory death (DCD) with an estimated 5000 or more patients on the waiting list.[1,2] At Derriford Hospital, as the tertiary referral centre for the South West, a total of 57 renal transplants were performed within the same time period: 17 living, 18 donation after brain death (DBD) and 22 donation after circulatory death (DCD). Twenty-one patients (39%) underwent renal ultrasound prior to hospital discharge. If there are concerns in the early post-operative period, ultrasound may be used to evaluate and diagnose complications. The principal aim is to identify those complications which may benefit from urgent surgical intervention. These include renal vein thrombosis, renal artery thrombosis, arterial kink and large perinephric collections. This paper demonstrates typical post-surgical sonoanatomy and identifies common early complications of renal transplant that can be depicted sonographically and are essential not to miss.

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2. Give a Kidney. *Why we need more altruistic kidney donors*. London: Give a Kidney, 2018, www.giveakidney.org/why-we-need-more-donors/ (accessed 13 March 2019).

Sonographic appearances of mid- and long-term renal transplant complications

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Abstract
Ultrasound (US) is the preferred imaging modality for evaluation of renal transplants in the immediate post-operative period and long-term follow up. This is namely due to its accessibility, inexpensive and non-invasive qualities. Upwards of 3100 renal transplants were performed in the UK in the last financial year. An estimated 5000 or more patients remain on the waiting list.[1,2] During the mid and late post-operative period and at routine follow-up, ultrasound may be used to evaluate the transplant and diagnose complications. It is important to understand that different complications occur at different stages

following a transplant. The complications seen at this stage are often managed medically, or with the assistance of interventional radiology. These include rejection, peri-nephric collections, vascular stenosis, ureteric stenosis, renal calculi, malignancy and recurrence of original pathology. In this imaging review, we aim to demonstrate typical post-surgical sonoanatomy and identify common mid and late urological, vascular and neoplastic renal transplant complications seen in the follow-up period.

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1. NHS Blood and Transplant. *Transplant activity report*. Bristol, NHS Blood and Transplant, 2018, www.organdonation.nhs.uk/supporting-my-decision/statistics-about-organ-donation/transplant-activity-report/.
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Case report: Splenic artery pseudoaneurysm, a rare complication of pancreatitis

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Abstract

Splenic artery pseudoaneurysm is a rare finding associated with chronic pancreatitis, acute pancreatitis, pancreatic pseudocyst or abdominal trauma. Formation of a splenic pseudoaneurysm is thought to be attributed to digestion of the splenic artery by pancreatic enzymes; the artery wall weakens, forming a pseudoaneurysm. A 79-year-old male was referred to ultrasound with known liver cirrhosis as part of a routine six monthly hepatoma screening. The patient had a history of chronic pancreatitis and a cholecystectomy six years ago. The ultrasound examination revealed an incidental, ill-defined complex mass in the left upper quadrant which measured 58 mm in diameter with turbulent arterial flow noted on colour Doppler. A follow-up CT scan confirmed a giant pseudoaneurysm arising from the splenic artery sited within a thick walled pseudocyst; there was no evidence of acute contrast extravasation to suggest rupture. The remainder of the pancreas showed progressive atrophy and calcification in keeping with chronic pancreatitis. The splenic vein was occluded as a consequence of previous pancreatitis with upper abdominal venous collaterals noted along with secondary gastric varices. Due to a high risk of rupture, the patient was referred to hepatobiliary vascular specialists. A follow-up CT several weeks later demonstrated a heterogeneous structure within the tail of the pancreas, most likely a combination of necrosis and chronic pseudocyst with the comment that the previously reported splenic artery pseudoaneurysm had spontaneously thrombosed. This case was an incidental finding; patients usually present with bleeding or abdominal pain. Almost half of patients who present have a concomitant pseudocyst. Embolization is one method of choice for treatment, alternatively surgical or conservative management. Ultrasound has the benefit of being readily available, a real-time dynamic assessment with no contrast required and relatively low cost.

MSK

Case report: Sonographic evaluation of sciatic nerve damage in a symptomatic patient following pellet shotgun injury

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Abstract

The aim of this investigation was to accurately determine the level and extent of sciatic nerve injury in a victim of pellet gunshot assault to the left lower limb. Upon initial plain film and CT assessment to exclude bone and vascular trauma, high resolution, sonographic evaluation of the right sciatic nerve was performed. Two dedicated MSK Radiologists performed high-resolution ultrasound evaluation of the sciatic nerve for the patient. Although the sciatic nerve remained in continuity (no nerve transection seen), at least three pellets were identified within the nerve sheath in the upper and mid-left thigh. Sonographic assessment of sciatic nerve for pellet injury is relatively fast, accurate and reliable and has significant advantages over modalities such as plain film, CT and MRI evaluation, which cannot precisely identify the relationship between pellets and nerve. The sonographic evaluation is also non-invasive.

Professional Issues

Isle of Wight peer review

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Abstract
Sonographer is not a protected title recognised by the HCPC at present, but there is continuing work to change this. Once this happens, there is likely to be a more robust expectation for review and regulation of work practices within the ultrasound profession. There remains no national requirement for regulation of sonography practice within a very diverse group of ultrasound practitioners. There is, however, a need for practicing sonographers to regularly audit the quality of their work, identify any potential errors and plan CPD and training needs around the outcomes. The BMUS Peer Review Toolkit was launched at the BMUS conference in Cardiff in 2015. The Toolkit was introduced into practice on the Isle of Wight in January 2016. There was early enthusiasm to use the toolkit to benchmark our work but it has been difficult to maintain the process for a number of different reasons. We have also found that the toolkit and peer review process have had some unexpected and sometimes adverse effects on our practice and throughput. We have continued to use the toolkit and adapted our practice in some areas as a result of the outcomes. The toolkit provides a benchmark for assessing the quality of imaging and reporting but does not include a review of professional practice outside of these processes. We believe that a full QA review should include all of these processes, so we have added systems to include these to our overall QA programme.

Are we doing enough to protect patients?

J Burnage
JB Imaging Solutions, Manchester, UK

Abstract
Whose responsibility is it to 'police the practitioners'? Every one of us has colleagues we would want to scan us if we were in need and it is highly likely that everyone of us also has a list of colleagues (past or present) whom we would not want to scan us. But what are we doing about it? How are we protecting patients from people who we wouldn't have scanning our friends and family? What are employers/managers/commissioners/providers doing to ensure that those performing ultrasound are doing what their CV/references/agency say they can do and to a level deemed acceptable? Where are lines of accountability drawn and who draws those lines? Breathing a sigh of relief when we 'get rid of' a poor performer is understandable but it is also unacceptable to do nothing else. I believe that the health and safety of patients is being compromised and until the industry as one puts strategies in place to ensure that information is shared, we are all complicit in the harm that comes from turning a blind eye.

Veterinary

Hepatic diseases differentials in dogs and cats

M Lobacz
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Abstract
Differential diagnosis divided for focal or multifocal disease: differentiation of hepatocellular carcinoma with hepatocellular adenoma cannot be done alone with ultrasound; CT contrast is needed. Hepatocellular carcinoma: central (79%), marginal enhancement (93%) in the arterial phase; cyst like lesions (93%); capsule formation (93%) and hypoattenuation in portal (86%) and equilibrium phase (93%). Hepatic adenoma: diffuse enhancement pattern during the arterial phase 57% which was also found in nodular hyperplasia 60% but never in hepatocellular carcinoma; contrast retention more frequent than other groups; nodular hyperplasia: isoattenuation in the equilibrium phase, likely to have capsule structure 20%. Target lesions were associated with malignancy in 67% instances. However, may represent benign nodular hyperplasia, pyogranulomatous hepatitis, cirrhosis, chronic active hepatitis and others. Haematoma: The internal appearance changes as it ages. Acute haemorrhage $<$24 hours old is echogenic; within the first week haematoma becomes more hypoechoic and better defined, with a mixture of solid and fluid components. Over the next several weeks, the haematoma becomes increasingly less distinct as fluid is resorbed and spaces are filled with granulation tissue. Acute abdomen in case of liver lobe torsion may mimic hepatic mass, it is hypoechoic or mixed echogenicity, use Doppler – absent or reduced blood flow. Left lateral liver lobe predisposed in large breed dogs. Diffuse liver diseases: hepatic congestion due to right sided insufficiency such as: (1)

Cardiac tamponade causing increased pressure within the CVC => hepatic veins appear dilated, the liver is enlarged and diffusely hypoechoic; (2) Caudal vena cava obstruction. Hepatomegaly due to the endocrine diseases: hyperadrenocorticism, hypothyroidism, diabetes mellitus, hepatitis and due to neoplasia. Linear branching mineral opacities in canine liver may be due to the previous cholangiohepatitis – incidental finding – predisposed CKCS. Biliary tract diseases: Gallbladder wall thickening: cholecystitis, oedema, cystic mucosal hyperplasia, rarely neoplasia. Gallbladder mucocele suspected rupture – to cut or not to cut? All depends on the clinical presentation of the patient. Clinical signs, although sometimes absent, include abdominal pain, inappetence, fever, vomiting and icterus. Predisposition with hyperadrenocorticism. Distention of the intrahepatic biliary tracts indicates biliary obstruction >7 days long.

Small animal musculoskeletal ultrasound

O Taeymans
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Abstract
Ultrasound is very suitable for examining musculoskeletal structures. It is too often forgotten as a complementary imaging modality to radiographs, and instead should be considered as a logical next step before resorting to using more expensive imaging modalities. Most musculoskeletal applications require a high-frequency (>10 MHz) linear transducer. Very superficial structures may require the use of a stand-off pad to display these structures at a greater image depth, where image resolution is better. Most common indications are evaluation of the tendons surrounding the shoulder (biceps, supraspinatus and infraspinatus), soft tissue abscesses, and foreign bodies. Other tendinous structures that are commonly evaluated are the psoas muscle insertion, the gastrocnemius origin, the common calcaneal tendon insertion, the abductor pollicis longus, patellar ligament and the abdominal wall. Joint effusion, synovial proliferation, joint neoplasia, myositis and muscle tumours can also be evaluated, whereby ultrasound can further assist in obtaining samples for cytology/histology or guide the injection of steroids. Despite not being able to travel through healthy bone, ultrasound can be very helpful in assessing pathologically affected bone. Monitoring fracture healing by differentiating fibrous vs. bony callus formation and assessing vascularisation of the callus, diagnosing osteomyelitis, bone tumours, as well as detecting small osteophytes not detectable on radiograph are occasionally performed. Less rewarding results have been reported for the diagnosis of hip dysplasia, avascular necrosis of the femoral head, medial coronoid pathology, osteochondrosis of the shoulder and tarsal joints, as well as assessing cranial cruciate ligaments, articular cartilage and menisci.

What difference has ultrasonography made in veterinary anaesthesia

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Abstract
In the last few years, the use of ultrasound increased significantly in the field of veterinary anaesthesia. For many loco-regional anaesthesia techniques, ultrasonography serves as a useful alternative or complementary technique to the use of peripheral nerve stimulator. Due to direct visualisation of targeted nerves, it allows for local anaesthetic dose reduction, increased block precision and reduced risk of nerve damage. Furthermore, ultrasonography allowed to develop completely new group of loco-regional anaesthesia techniques called intrafascial/compartmental bocks. They facilitate predictable anaesthetic spread via use of anatomical fascias. Due to hypoechoic character and superficial location of most fascias these blocks are classified as low-risk and easy to master loco-regional techniques. The serratus plane block designed for thoracic wall procedures and transversus abdominis plane block for abdominal procedures will be presented as an examples. Finally, ultrasonography is currently used for peripheral nerve/plexuses catheter placement which due to the use of differential block phenomenon, allows for more effective management of acute postoperative pain. Overall, ultrasonography due to improvement and widening the spectrum of available loco-regional anaesthesia techniques facilitates the way towards opioid-free analgesia in veterinary profession.

Prevalence and clinical significance of the medullary rim sign identified on ultrasound of feline kidneys

A Ferreira, R Marwood, T Maddox and J Mortier
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Abstract
The medullary rim sign (MRS) is a recognised ultrasonographic (US) feature of feline kidneys that has been identified in normal and diseased kidneys. The objectives of this study were to determine the prevalence of the MRS in a population of cats from a referral hospital and identify if the presence, or any specific US features, of the MRS are associated with renal disease. Renal US images from 661 cats were reviewed and cases with an MRS identified. An equal number of time control cases without a MRS were collected and compared in a retrospective case-control study. Medical data retrieved included age, weight, sex, breed, biochemical results, urinalysis results and final clinical diagnoses. US images and reports were reviewed and the MRS presence, thickness, intensity, symmetry, changes on repeat US scans as well as additional renal US findings were recorded. Associations between independent variables and the MRS were examined with conditional and unconditional logistic regression. In the 661 reviewed cases, 243 (36.8%; 95% CI: 33.1–40.1) showed a variation of the MRS; thin and thick medullary rims were identified in 133 (54.7%) and 110 cases (45.3%) respectively. A thick MRS in the presence of additional renal findings (loss of corticomedullary definition, pyelectasia and reduced size) was associated with renal disease ($P = 0.03$). The presence of a thin rim only, was associated with an absence of renal insufficiency, although this was not a significant association. There was an association between the presence of MRS and a final diagnosis of feline infectious peritonitis ($P = 0.045$). Hypercalcemia was not associated with the presence of MRS ($P = 0.52$). The MRS is a common finding in cats. Based on these results a thin MRS is usually a nonspecific finding not associated with renal insufficiency or hypercalcemia. A thick MRS in combination with other US findings is associated with renal disease.

New Technologies for Clinical and Preclinical Research

Opening the blood–brain barrier with an implanted ultrasound device for increasing the penetration of carboplatin into the brain: Preclinical and clinical results

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Abstract
The blood–brain barrier (BBB) limits the penetration of most drugs into the brain. Pulsed ultrasound in combination with injected microbubbles can transiently disrupt this BBB to increase the passage of drugs to brain tissue. An implantable unfocused ultrasound source operating at 1 MHz, SonoCloud, was used to repeatedly disrupt the BBB in patients with recurrent glioblastoma (GBM) prior to carboplatin chemotherapy. The goal of the presentation will be to describe recent pre-clinical work on carboplatin activity in glioma models as well as an update on the clinical work. Experiments were first performed in a primate model in order to assess the carboplatin chemotherapy distribution after BBB disruption. Then, efficacy of combined carboplatin and BBB disruption was evaluated on mice bearing orthotopic human GBM xenografts. A first-in-man clinical trial at the University Hospital Pitié Salpêtrière, APHP, Paris, France was conducted. GBM patients with tumor recurrence had surgery to implant the SonoCloud device. It was then operated monthly in a < 10 minute procedure in conjunction with IV administration of carboplatin and microbubbles. Patients were monitored clinically and T1w contrast-enhanced MR images were used to visualize BBB disruption. BBB disruption resulted in a significant local increase of Carboplatin concentrations in the primate model and an increase in survival in GBM mouse models. Twenty-five patients were included in the study and 85 sonications were performed. BBB disruption was visible on MRI and depended on the applied ultrasound pressure. No carboplatin-related neurotoxicity was observed and only minor related adverse events were observed. Pulsed ultrasound with the SonoCloud device was well-tolerated and may increase the effectiveness of drug therapies in the brain. Future work will aim at improving the efficacy of the treatment by sonicating larger volumes of brain.
Clinical trial information: NCT02253212.

Non-linear acoustic emissions from therapeutically driven contrast agent microbubbles

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Abstract
Non-linear emissions from microbubbles introduced to the vasculature for exposure to focused ultrasound are routinely monitored for assessment of

therapy and avoidance of irreversible tissue damage. Yet the bubble-based mechanistic source for these emissions may not be well understood. In this presentation, dual-perspective high-speed imaging at 210,000 frames per second (fps), and shadowgraphically at 10 Mfps, is used to observe cavitation from microbubbles flowing through a 500 μm polycarbonate capillary, exposed to focused ultrasound of 692 kHz at therapeutically relevant pressure amplitudes. The acoustic emissions are simultaneously collected via a broadband calibrated needle hydrophone system. The observations indicate that periodic bubble-collapse shock waves dominate the non-linear acoustic emissions, including subharmonics at higher driving amplitudes. Contributions to broadband noise through variance in shock wave amplitude and emission timings are also identified. Possible implications for in vivo microbubble-cavitation detection, mechanisms of therapy and the conventional classification of cavitation activity as stable or inertial are discussed.

Development of a 1-D linear phased ultrasonic array for intravascular sonoporation

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Abstract
Sonoporation is a minimally invasive targeted drug delivery technique that relies on high-power ultrasound to cavitate microbubbles (MBs) in the proximity of cells. The therapeutic purpose is to increase the cells' permeability to exogenous agents and thus improve the efficacy of drugs in the treatment of various pathologies. External hepatic sonoporation is particularly difficult because of the ribs, which lead to heat deposition through ultrasound attenuation and beam scattering. Liver movement during patient respiration and the surrounding fat layer are other complications. The objective of the current work is to design an 11-Fr catheter transducer that overcomes these issues by providing sonoporation intracorporeally from within a larger hepatic vein. The transducer is a 1-D linear phased array made of 1–3 piezocomposite material. The active materials investigated are ceramic (PZT-5H) and single-crystal (PMN-29%PT and 26%PIN-PMN-32%PT) and are coupled with a polymer filler (EpoFix, Struers, UK). The array behaviour was simulated using finite element modelling (FEM) (PZFlex, Onscale, Cupertino, CA, USA) and its performance was improved through a parametric sweep of volume fraction and aspect ratio. The monitored output was peak negative pressure (PNP) which is related to cavitation threshold and sonoporation efficiency. Two operating frequencies were investigated: 1.5 MHz, limited by transducer thickness compatible with catheter diameter, and 3.0 MHz, approximate MB resonance. The number of array elements is 24 for the lower frequency array and 32 for the higher frequency one. The array elevation is 2.4 mm and the length is approximately 10 mm. A total of six transducer arrays are currently being prototyped using the dice and fill method. The wiring of the transducers is achieved with a flexi circuit applied on the back of the array using conductive paint while the front of the transducer is grounded with a single electrode. A microballoon-filled epoxy backing is present to provide transducer robustness. The parametric sweeps showed that one pillar per element in the array length direction achieves the lowest PNP for all cases. Electrical impedance simulations related reduced array elevation to lateral reflections and a decrease in overall performance. The two single crystal active materials proved to have similar efficiency but were 33% better than the ceramic. PNP at the focal point of the arrays was around −4 MPa at 1.5 MHz and −17 MPa at 3.0 MHz for an excitation signal of 200Vpp. A single element transducer was designed and manufactured for model validation and sonoporation tests. The impedance measurements of the manufactured transducer indicate that the electrical resonance frequency aligns well with the model, but the coupling coefficient is reduced. Pressure maps in water show the beam shape is similar to the model and the PNP is half that of the model which is attributed to FEM assumptions of perfect electrical matching and higher piezoelectric coupling coefficients. Future work will involve finalising the array fabrication and characterisation. The transducers will be tested for cavitation efficiency using high-speed video imaging and passive acoustic mapping. Sonoporation tests will be performed in vitro and a liver phantom will be used for pressure and temperature measurements. Finally, the transducer will be implemented in a catheter.

QUANTuM: A CSO Knowledge Transfer Partnership focusing on quality assurance in MR-guided high-intensity focused ultrasound

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Abstract
MR-guided high-intensity focused ultrasound (MRgHIFU) is a novel therapy that exploits MR guidance to deliver targeted sustained ultrasound heating to cancerous lesions.[1,2] In the UK, the procedure has so far been NICE approved only for prostate cancer and benign tumours (fibroids), but has the potential to treat most cancer lesions and be used for neurological diseases and palliative care.[1–4] Treatment protocols and quality assurance procedures in place for such therapies are far behind those of other established techniques, such as radiotherapy. This lack of robust and standardised procedures is contributing to limit the diffusion of this therapy. In July 2018, Guy's and St Thomas NHS Foundation Trust and National Physical Laboratory set up a 12 months NHS Knowledge Transfer Partnership, supported by the Chief Scientific Office (CSO), BMUS, the Institute of Cancer Research (ICR), Therapy Ultrasound Network for Drug Delivery and Ablation Research (ThUNDDAR), and the Institute of Physics and Engineering in Medicine (IPEM) and collaborators at King's College London. The aim of the collaboration is to develop Quality Assurance and Treatment planning for MRgHIFU (QUANTuM) and facilitate dissemination of the procedure in UK. This is a report on the first five months of collaboration, and the longer term plan, including both scientific and system leadership developments.

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Experimental variation in the measurement of ultrasound fields

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Abstract
Measurement-based simulation of ultrasound fields is important for accurate prediction of in situ exposure levels in both ultrasound therapy and diagnosis. To ensure the simulations are accurate, thorough experimental validation is required. Sources of error can arise from both the model and measurement, and must be understood in order to determine the level of agreement between the model and the measurement. This talk discusses sources of error in measurements of acoustic pressure arising from properties of the source, measurement equipment and data processing. The variation in repeated measurements of ultrasound fields, as well as comparison of measurements of ultrasound fields made with a range of hydrophones is presented and the implication for model validation is discussed.

A new protocol for in vitro study of low intensity pulsed ultrasound

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Abstract
Clinical trials have shown that low intensity pulsed ultrasound (LIPUS) stimulates healing of fractured bone.[1] Numerous in vitro studies investigated LIPUS effects by measuring cellular markers of bone regrowth, such as Prostaglandin E2 (PGE2).[1] However, comparison of results is difficult because the acoustic field is often inadequately characterised or affected by the set-up. In addition, mechanical bioeffects are the most likely mechanism of LIPUS stimulus,[1] implying peak negative pressure ($p-$) is the best indicator of LIPUS dose. But the LIPUS field is usually defined by intensity (I_{SATA}). This pilot study tested a robust and repeatable protocol for in vitro investigation of LIPUS, with a new definition of dose based on $p-$. Custom-built 'biocells' were seeded with MC3T3-E1 osteoblasts (50,000 cells/cm^2) and incubated overnight. The biocells consisted of circular 3D-printed frames (VeroGray^{TM}) bounded by 6 μm-thick Mylar (Goodfellow, UK) forming an acoustically transparent window and cell growth surface. Cells and media were injected via self-sealing septa (Merck, UK). A purpose-built transducer (Ferroperm

PZT27, 25 mm diameter) was driven with a LIPUS pulse (frequency 1 MHz, pulse width 200 μs, repetition rate 1 kHz) to produce maximum peak negative pressures ($\hat{p}-$) up to 500 kPa at 100 mm from the front face. Beam patterns were measured with a 0.5 mm needle hydrophone (Precision Acoustics, UK). The average LIPUS dose was estimated by averaging $p-$ across the biocell window area ($p-, SA$). Transmission measurements through the biocell window confirmed the acoustic field was not altered. After incubation, biocells were filled with media and mounted so the cell layer was 100 mm from the transducer. They were then exposed to 20 minutes LIPUS ($\hat{p}- = 0$ kPa to 500 kPa) in a tank of sterilised water at $37 \pm 2^{\circ}$C. After exposure, all but 5 ml of media was removed and the biocells incubated for 20 hours. PGE2 concentration in the media was measured by enzyme-linked immunosorbant assay (Abcam AB133021) and microplate reader (Tecan, AT). PGE2 up-regulation was significantly enhanced at $\hat{p}- = 100$ kPa ($p-, SA = 21$ kPa), corresponding to I_{SATA} close to that of typical LIPUS fields. To date, the ultrasound exposure method has only been repeated once, but the results give early confidence in the methodology. However, cell adhesion was an issue and future work will focus on developing the method to improve this, plus the robustness of the 'biocell' frames and tank temperature variation. Cell proliferation will also be considered. The final method will enable a controlled investigation of optimum LIPUS fields, focussing on low frequency, to provide quantitative assessment of how ultrasound can promote bone healing at frequencies representative of commercial ultrasonic osteotomy devices.

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Machine learning for cavitation detection

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Abstract

This talk presents some work in progress on applying techniques from machine learning to cavitation detection. Machine learning can be used to find generalizable predictive patterns from a training data set. This predictive capability aims at forecasting unobserved outcomes, without necessarily knowing how a system fully works. Indeed, one of the advantages of machine learning is that it can be effective when the data are acquired without a carefully controlled experimental design, when there is variability between experimental setups, or in the presence of complicated nonlinear interactions. However, a robust algorithm requires the selection and extraction of a number of features. A feature is an individual measurable property or characteristic of the phenomenon being observed. Ideally, features should be independent, informative and discriminating, encapsulating all the required information about a system. The majority of the literature on cavitation detection has been based on statistical methods, typically using integrated broadband noise as the dominant feature for determining the thresholds at which inertial cavitation is likely to occur. There is an increasing recognition of the need for standardisation in both the detection and the reporting of cavitation activity. In this talk a number of features, extracted from both time- and frequency-domain information from both continuous and pulsed exposures in water are described and a classification algorithm presented. The advantages and disadvantages of the features and the experimental consequences of attempting to capture all the possible features is discussed, as well as possible extensions to the include models which can distinguish between types of cavitation, or attempt to predict quantities from a given exposure.

Modulating brain activity with focused ultrasound: Feasibility, challenges and recent breakthroughs

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Abstract

Transient ultrasonic neuromodulation has been demonstrated in rodents,[1,2] non-human primates[3] and humans.[4] Transcranial ultrasonic brain therapy at frequencies higher than 500 kHz requires adaptive focusing to compensate for the aberrations induced by the skull bone. Nevertheless, challenges remain, such as how to illicit sustainable effects, and how to precisely target deep seated targets in human brains (Lee et al.[4] was limited to cortical stimulation). We will show here that the effects of ultrasonic neuromodulation can be extended to 30 minutes by optimizing the ultrasonic parameters. Moreover, we will present a novel low-cost technique to focus ultrasound beams deep into human brains. Transcranial focusing is currently achieved by using multi-element arrays driven by a dedicated

multi-element electronics. A growing number of elements were used to improve the focusing: 64 elements in 2000,[5] 300 in 2003,[6] 1024 in 2013[7] and with more to come. We will present some of the salient results obtained pre-clinically and clinically with such multi-element transcranial devices. Nevertheless, we will show that comparable transcranial focusing can be achieved with a novel approach in rupture with the current trend. It consists in a single-element covered with a 3D silicone acoustic lens of variable and controlled thickness. Similar lenses have been introduced in the past to perform single or multiple focusing patterns in homogenous propagating media[8] but recent 3D printing and milling capabilities make tailor-made 3D lenses a feasible option for transcranial adaptive focusing.[9]

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A preclinical study of the combinatorial effects of pulsed focused ultrasound and immune checkpoint inhibitors in pancreatic cancer

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Abstract

The clinical benefit of immunotherapy has not yet been realised in pancreatic cancer, which is characterised by a low antigenicity and dense stroma profile. Focused ultrasound (FUS) can be used in the treatment of solid tumours, either by inducing necrosis (using ablative temperatures), or by creating cavitation which results in mechanical disruption of the stroma. Both of these processes may regulate the immune response and make the tumours more susceptible to immunotherapeutic treatments. In this study, pancreatic tumours have been exposed to pulsed FUS and co-treated with immune checkpoint inhibitors (ICI) to explore whether control of the tumour growth can be achieved. Syngeneic orthotopic KPC pancreatic tumours (KrasLSL.G12D/+; p53R172H/+; PdxCre tg/+) were grown in immune-competent murine C57BL/6 subjects (>15 weeks old). Tumours were exposed to pulsed FUS using the small animal Alpinion VIFU 2000 Therapeutic ultrasound platform. Pulsed FUS exposure parameters were designed to result in cavitation (power = 200 W, duty cycle = 1 %, pulse repetition frequency = 1 Hz, 25 repeats) in the target tissue. A combination of anti-CTLA4 and anti-PD-1 antibodies were administered intraperitoneally three days before treatment, and every three days thereafter. Tumour growth was estimated using high-frequency ultrasound imaging, and with callipers at the time of culling. Pulsed FUS treatment of pancreatic tumours resulted in cell and collagen depleted regions in the tumours, associated with an extensive rearrangement of the extracellular matrix. No skin damage was observed. Combination of a single pulsed focused ultrasound treatment with administration of ICIs resulted in improved control of tumour growth relative to the monotherapies and sham exposures. Additional results for the systemic and localised abundance of immune cells will be presented.

Frequency optimisation for opening the blood–brain barrier

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Abstract

Significant advances have been made in the development of therapeutic agents for the treatment of neurodegenerative diseases, psychiatric illnesses and brain cancers. However, the blood–brain barrier (BBB) presents a major impediment to the delivery

of larger molecules into the interstitial fluid of the brain, which severely limits the clinical efficacy of these agents. There is now well-established evidence that ultrasound can reversibly and selectively disrupt the BBB. One remaining challenge in the transcranial application of ultrasound is that the skull can lead to significant attenuation and aberration of the transmitted waves, which affects the quality of the ultrasound focusing, and thus the targeting and specificity of the BBB opening. This can be overcome using lower frequency ultrasound waves (below 500 kHz); however, this increases the presence of standing waves, which can have a similarly deleterious effect on treatment specificity. The purpose of this ThUNDDAR-funded pilot study is to carefully examine the interplay between the ultrasound drive parameters and the transmission loss, aberration and standing waves caused by the skull. In this presentation, we report preliminary results from the study.

Non-bubble mechanisms of sonothrombolysis

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Abstract
Sonothrombolysis or ultrasound-accelerated thrombolysis is the dissolving of blood clots with ultrasound (and often microbubbles). Exogenous microbubbles, under appropriate conditions, can greatly accelerate sonothrombolysis, but there is also evidence that endogenous microbubbles form during clotting. Overpressure experiments show that about half of the acceleration due to ultrasound persists in the absence of bubbles. What is the mechanistic basis of this effect? Based on fundamental physical and biochemical mechanisms, the presentation will highlight outstanding problems with understanding the non-bubble components of sonothrombolysis.

Photoacoustic imaging with photothermal therapy and gold nanorods for a new approach to lung cancer management

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Abstract
Plasmonic gold nanorods (AuNRs) show potential for use in a range of cancer diagnostics and therapeutics when combined with photoacoustic imaging (PAI) and/or plasmonic photothermal therapy (PPTT). Generally in PPTT, continuous wave (CW) lasers are used to destroy cancerous tissue through bulk heating. However, in order to add a diagnostic component through PAI, a pulsed wave (PW) laser is needed. If PPTT can be achieved using PW lasers then combined theranostic applications with the same laser system is possible. Additionally, AuNRs can be many different sizes but exhibit equivalent surface plasmon resonances (SPRs) so the size may be significant in the efficacy of these modalities. Endobronchial ultrasound (EBUS) is routinely used as part of the patient pathway in order to stage and guide needle biopsies of suspected cancerous regions. EBUS, if combined with nanorods, PPTT and PAI could present a new approach to both identify and treat lung cancer, one of the deadliest forms of cancer, without the need for surgical intervention and/or, radio or chemotherapy. A tuneable 7 ns PW laser was used to irradiate AuNR solutions at their specific SPRs across a fluence range of 1–40 mJ cm^{-2} to determine AuNR melting thresholds. The photoacoustic (PA) emissions from AuNRs with four different lateral widths (10, 25, 40 and 50 nm) across a range of equivalent concentrations were measured, and their PA emission amplitudes calculated via a technique similar to PA image reconstruction. These were also imaged in a pre-clinical photoacoustic system, the inVision MSOT 128 to provide direct comparison. The four AuNR sizes were used for PPTT in a lung cancer cell line (A549), irradiated for 5 minutes with the same PW laser (fluence below the melting threshold) as well as a CW laser (1.5 W/cm^2) for comparison. The results indicate that larger AuNRs produce stronger PA signals but are more prone to melting compared with the smallest AuNRs (10 nm), suggesting that AuNR size has a significant effect on PA response. The PPTT efficacy of the four AuNR sizes on an A549 cell line was determined and the temperature profile monitored via a thermal imaging camera. These results suggest that a PW laser can achieve increased cell death without bulk heating. An in-house diagnostic ultrasound imaging system was used to mimic EBUS in tissue mimicking phantoms demonstrating the potential to use PAI with this established imaging modality.

A technique for predicting HIFU acoustic intensity using only electrical measurements

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Abstract
Acoustic intensity (AI) is the most common way to control the volume of thermally formed lesions. It can be measured accurately using a radiation force balance (RFB) or estimated using hydrophone measurements. Whilst RFBs are the gold standard, their expense obstructs new researchers from accurately calibrating their HIFU exposures. Both measurements are performed with the transducer in water (i.e. free field), which are then converted into in situ parameters through the application of various models of attenuation. Thus, the introduction of a technique for monitoring acoustic output in real time would greatly benefit treatment planning and the clinical use of HIFU. The peak excitation voltage may be used as a control, but it requires calibration and is not immune to variances in transducer manufacturing or differing excitation circuitry. In this study, it was found that a current probe could be used to predict AI. In the frequency domain, voltage and current waveforms were multiplied to find electrical power. The real components of the power were numerically integrated and a conversion efficiency of 80% was presumed to predict the acoustic power. To find acoustic intensity, the focal volume was approximated using the transducer dimensions. This technique was tested by lesioning ex vivo chicken breast at three AIs (700, 1000 and 1400 W/cm^2) using a switched circuit and a linear amplifier. Compared with using an RFB, the AI and lesion volume were the same ($p \gg 0.05$) irrespective of the hardware used when using the described technique. Using only voltage to predict AI produced significantly different intensities and lesion sizes ($p \ll 0.05$). The results show that it is possible to predict AI without using an RFB. This may make HIFU research more accessible to new researchers and be useful for characterising large multi-element transcranial arrays quickly.

Development of an experimental platform for rapid prototyping of UmTDD methods

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Abstract
Ultrasound has been shown to trigger drug release[1] and enhance the uptake of low- and high-weight molecules in cells and tissues.[2,3] Although ultrasound itself can induce biological effects, ultrasound-mediated targeted drug delivery (UmTDD) uses microbubbles (μB) to enhance ultrasound effects UmTDD can reduce cytotoxic drug dose, improve local drug delivery, and reduce suffering in cancer treatments. Although ultrasound interaction with blood vessels and μBs has been thoroughly studied, the mechanisms and efficiency of UmTDD in real systems remains unclear, limiting the utility in vitro systems to optimise UmTDD protocols. Developing UmTDD protocols appears to be an extremely challenging task given all the parameters to take into consideration in real systems, being capillary size, shape and morphology the most important features, as they play a relevant role in μB flow and behaviour, directly affecting UmTDD efficiency. Furthermore, experimental testing of UmTDD presents high ethical costs due to the use of animal testing.[4,5] In this work we present a new approach to control all the relevant parameters for UmTDD treatments from micro-computer tomography (μCT) data . This approach uses the stereolithography (STL) 3D-printing technique (allowing 3D-printing microchannel widths down to 200 μm) to develop capillary phantoms based on the real systems obtained from the μCT scans, which can further be used to develop controlled protocols allowing a deeper and more detailed study of the phenomena involved in UmTDD with minimal animal use.

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Day 3 Thursday 6 December

Obstetrics

Antenatal diagnosis of congenital heart disease over a two-year period in an NHS tertiary referral centre

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Abstract
Antenatal detection of congenital heart defects (CHD) allows parents to make decisions about pregnancy outcomes and improves neonatal morbidity and mortality. By auditing all the cases of CHD detected antenatally, we can ensure we are meeting national standards for detection and management of CHD. This would help us to improve detection rates as well as identify areas of improvement in the management of these women. We carried out a retrospective audit of CHD cases diagnosed antenatally between January 2016 and December 2017. Patient demographics, cardiac views recorded, time-frames for diagnosis and pregnancy outcome were compared against FASP standards, the East Midlands Network referral pathway and national CHD data. Twenty-three cases of CHD were identified with 87% defined as severe. The mean maternal age was 28 years with 57% being nulliparous. None of the women had any medical problems and the average BMI was 24.8 kg/m^2. There was 100% compliance with the FASP cardiac views, which were completed by 23 weeks' gestation; 74% were live births, 17% ended in termination of pregnancy and one baby was stillborn. The mean birthweight was 2486 g with a mean gestational age at delivery of 36 weeks and 5 days. As per the regional referral pathway, 100% patients were reviewed by paediatric cardiology; 26% of cases had associated genetic causes. The screening service in this trust is meeting FASP and regional standards with regard to CHD in the majority of cases. There is inconsistent reporting of undiagnosed serious CHD at birth and in the immediate neonatal period or in cases of stillbirth. The national congenital anomaly reporting is now online; this will allow us to improve our reporting and identification of cases. The next step is to set up a local database which will allow more regular comparison with national standards.

Challenges to professional autonomy: Australian sonographers' experiences in communicating adverse outcomes to pregnant patients

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Abstract
Unlike the United Kingdom, Australia is yet to formalise the sonographer practitioner role allowing for independent reporting and communication with patients. This research explored the role of Australian sonographers in communicating adverse outcomes in obstetric ultrasound. Advances in ultrasound imaging place sonographers as the frontline practitioner with patients expecting to know scan results immediately. Communicating adverse outcomes is often left to the sonographer, who may feel unsupported and conflicted in deciding whether to convey this information to the patient. Members of the Australasian Sonographer's Association qualified to perform obstetric ultrasound completed a survey ($n = 249$) seeking their views and practices on reporting an adverse outcome. Both quantitative and qualitative data were derived from the 33-item instrument. The majority of participants reported that conveying an adverse outcome should be part of the sonographer role, however, they acknowledged the difficulty of doing this without recognition of their professional status and autonomy, and acknowledged that it was, to some degree, dependent on the diagnosis. Most agreed they would communicate a definitive diagnosis such as 'no fetal heart beat', whereas it was more difficult with a fetal abnormality. Policy and protocols recognising the professional status of sonographers and providing a supportive framework for their practice are needed so that all stakeholders (patients, sonographers, radiologist/sonologist) understand and accept the sonographer role. This should occur irrespective of the type of practice or location so patients can expect uniformity. The United Kingdom model of the sonographer practitioner with independent and autonomous reporting and communication could be a starting point for Australia's sonographers.

To FASP or not to FASP? Investigating the impact of storing only FASP recommended anomaly images on patient recall rate

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Abstract
Anomaly scans are conducted at Nottingham University Hospitals (NUH) according to the national Fetal Anomaly Screening Programme (FASP) guidelines. Historically, imaging of the anomaly scan followed locally set guidelines which included storing a minimum of 23 images to PACS. A retrospective audit of anomaly scan recalls showed that the departmental recall rate was 20% in January and 22% in February 2018; however, for some sonographers, this was much higher, with the highest recall rate of a sonographer being 93%. The ultrasound clinical specialists worked with individual sonographers with the highest recall rates. It was found that scan technique was good; however, several sonographers were recalling patients if they could not achieve all of the specified images. Some sonographers were also storing up to 70 images per anomaly scan. Consultation with the obstetricians and foetal maternal medicine specialists was undertaken and an agreement was made to trial a new way of working within the department. For a two-month period, the number of specified images to be stored was reduced to 9 to assess the impact on the recall rate and sonographers confidence in completing anomaly scans. During the trial period, the recall rate for the department reduced to 8%, with individual rates reducing from 93%, 87% and 54% to 19%, 20% and 7%, respectively. Sonographer views on the new ways of working were also found to be positive. By employing new guidelines during the trial period, confidence levels of sonographers increased and the recall rates reduced. This had a positive impact on the scan capacity within the department. Recommendation for this to become a permanent change to guidelines has been approved and implemented as a new way of working.

Improving confidence of sonographers when performing obstetric middle cerebral artery Doppler

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Abstract
Doppler ultrasound in obstetrics plays a vital role in identifying and monitoring those foetuses at risk of perinatal mortality or morbidity due to uteroplacental insufficiency. The middle cerebral artery (MCA) Doppler is fundamental in assessing foetal cardiovascular distress, anaemia and hypoxia. The Royal College of Obstetricians and Gynaecology[1] suggests an abnormal MCA Doppler in a growth restricted foetus has a predictive value for acidosis at birth and therefore should be used to time delivery. Therefore, in the appropriate situation, MCA Doppler assessment can be a useful addition to the umbilical artery Doppler assessment, thus improving perinatal outcome.[2] Performing accurate MCA Doppler assessment is an advanced technique, requiring a high level of operator skill for technically well acquired and optimised images to be produced.[3] Currently, MCA Doppler is performed by consultants at the Royal United Hospital, Bath or by a foetal medicine specialist at the regional foetal medicine unit. Consequently, sonographers have limited exposure in performing MCA Doppler, impacting on the confidence and ability to perform the technique when required. Necas[4] highlights the need for appropriate training and an awareness of the potential pitfalls, allowing technical expertise to overcome any problems that may impact the overall accuracy of diagnosis. The aim of this pictorial review is to outline the optimum technique alongside the common pitfalls in performing MCA Doppler assessment and how to overcome these. This should act as a useful guide in standardising and improving the technique of acquiring an accurate MCA Doppler, thus improving the confidence of sonographers in producing optimum MCA Doppler and providing the clinicians with an accurate diagnosis to aid clinical decisions.

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Evaluating expertise – Is saving images a good thing

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Abstract
Since 2007, the 20 week fetal anomaly scan (FAS) is offered to all pregnant women as part of the national prenatal screening program in the Netherlands. In order to maintain and assess the quality of scanning, an image audit is performed every two years. Due to the initial absence of national quality criteria for the assessment of ultrasound images obtained at the FAS, the Foundation Prenatal Screening Southwest region of the Netherlands developed a standardized qualitative image scoring method. We evaluated in two consecutive assessment periods whether this method influenced the scanning quality and whether quality was maintained. Each sonographer was requested to make three logbooks consisting of 25 anatomical and/or biometrical images per fetus. The examinations are selected by the auditing authorities. The images receive 1 credit per adequate magnification and plane and 1 credit if biometrical assessment is performed with correct caliper placement. A score of less than 75% is considered inadequate. The score is reported back to the sonographers. The logbooks are assessed by four experienced prenatal medicine physicians. During the first round between 2012 and 2015, 255 logbooks were assessed of 85 sonographers. The majority of the sonographers (86%) had a sufficient score but 12/85 failed the criteria. Reassessment of new logbooks within three month of the first quality control showed for 11 sonographers a sufficient score. One sonographer stopped scanning before reassessment. In the second round between 2016 and 2017 the logbooks of 87 sonographers were assessed. The percentage of sonographers with a sufficient score was 93% and reassessment was required for six sonographers. Reassessment of new logbooks showed for four out of five sonographers a sufficient score and one sonographer stopped scanning. Qualitative assessment can induce a better performance of the 20-week FAS and create awareness for maintaining a high standard of scanning.

A retrospective study investigating the use of MCA/UA Doppler pulsatility index ratio as a prediction for interventions and poor obstetrics outcomes in the case of reduced foetal movements

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Abstract
Approximately 60,000 infants per annum are born growth restricted in the UK, 1000 of whom die as a result.[1] So, despite the changes and desire to improve the service, there are still many babies that are being missed under the current protocols. With more pressure being put onto sonographers to produce accurate scans with multiple elements in packed patient lists are we producing the information that counts? At the forefront of research into reducing the still birth rate in the UK mothers with reduced movements are a key population. Haran and Everett[2] explain in their study that a foetus compromised by placental dysfunction and hypoxia undergoes a physiological response causing the redistribution of blood to the heart and brain, eventually manifesting itself as a reduction in movements. Latest research has informed the introduction of middle cerebral artery (MCA) Doppler readings to all reduced movements scans which has provided the possibility of using the MCA/umbilical artery (UA) Doppler pulsatility index (PI) in the form of a ratio to identify intrauterine growth restriction and in turn the elusive 'at risk' fetus and this research aims to define its effectiveness and use. Retrospective data of scans performed due to reduced movements along with the data collected at the time of birth have been collated and will be analysed. The aim of the project is to try and define the key factors that lead to a decision to intervene and may decrease the still birth rate and reduce the need for intervention. By using logistical regression statistical analysis, it may be possible to predict poor outcomes or likelihood of intervention. There are thousands of serial growth scans performed for higher risk pregnancies in the UK each year and the use of MCA/UA PI ratio could be expanded to these growth scans.

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MSK

Case report: Dynamic ultrasound manoeuvre in anterior ankle impingement

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Abstract
Ankle injuries are common in collision sport such as rugby. The researchers report that 'ankle injuries account for between 8% and 20% of all injuries in professional rugby union league'. Commonly, the mean time lost from training and matches with ankle injuries is '61 days (range 21–240 days)'. So, making an accurate diagnosis, whilst challenging, may help direct the treatment, rehabilitation and return to play strategies in sports medicine. The injured player was a 31-year-old semi-professional rugby player, playing in the position of inside-centre. He was complaining of severe pain on the left ankle with swelling and a degree of ankle instability. He has mentioned that he was tackled from behind forcing the ankle into an awkward position which became trapped between pitch and opposing player. The opposition also landed with full body weight on his left ankle. He was referred to see the physiotherapy sonographer for an ultrasound scan for a second opinion. A dynamic ultrasound manoeuvre was selected to find the cause of the anterior ankle joint impingement syndrome. He was in the active standing position in the water bucket with ankle movement (neutral to dorsiflexion producing pain) during the investigation dynamically. There was a transverse calcific spur at the distal articular end of the tibia commonly called a 'footballer's ankle'. As a result, he potentially has a lateral ankle sprain grade II and a big osteophyte of distal tibia. Finally, we referred him to the orthopaedic consultant who has agreed and recommended a removal of the osteophyte of the distal tibia by arthroscopy and return to the sport in four months. This case study demonstrates that ultrasound imaging is very useful to confirm the physical assessment findings and diagnosis of ankle injuries especially, the dynamic evaluation is fascinating in presenting following the mechanism of anterior ankle impingement.

Case report: The groin – A case of a hydrocoele of the Canal of Nuck

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Abstract
The Canal of Nuck (CoN) was first described after a 17th century Dutch anatomist, Anton Nuck in 1691. It is an embryological anomaly whereby the processus vaginalis which normally obliterates in the first year of life remains patent providing a direct pathway into the female inguinal canal. Abnormal development of the CoN can lead to problems ranging from asymptomatic hydrocoele to herniation and incarceration of the pelvic organs. A female infant with an inguinal hernia should be thoroughly evaluated to determine whether the hernia contents contain fluid/uterus and/or ovaries. The ovaries are at increased risk of incarceration, torsion and subsequent infarction warranting urgent surgical intervention. Given the potential for morbidity, disorders of the CoN deserve greater awareness. A 15-year-old female presented for ultrasound assessment of a painless 3 cm mobile lump in the right groin for >1 week duration, which could have been a lymph node. The child was otherwise healthy with no relevant medical history or trauma. Physical examination revealed a small visible, fluctuant, palpable inguinal mass. Scanning over the lump revealed a thick walled fluid-filled compressible and reducible structure with movement of the fluid from the deep to superficial inguinal ring. The contralateral side revealed a similar but much smaller fluid filled structure. The appearances were consistent with bilateral hydrocoeles of the CoN. A hydrocoele of the CoN is the female equivalent of a spermatic cord hydrocoele in males. Many clinicians including surgeons are not aware of this anatomical structure of the CoN and the pathology it may contain. Although this anatomic anomaly is a rare entity, understanding the anatomy and embryology of the CoN is an essential requisite for recognition and interpretation of the related findings.

Ultrasound confirmation of heterotropic new bone formation after distal biceps tendon rupture repair

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Abstract
Heteroptropic ossification (HO) describes bone which forms in a location where it would not be usually seen, such as muscle, soft tissue and ligaments. HO can be divided into three main subtypes: (i) myositis ossificans progressive – a rare genetic condition; (ii) traumatic myositis ossificans – post-trauma, muscle tear etc; (iii) myositis ossificans circumscripta – without trauma, but occurring after neurological injury or burns. This case report focuses on traumatic myositis ossificans, which is a common complication post-distal biceps tendon rupture repair. A 33-year-old gentleman attended the York ED following hyperextension injury to his left arm whilst at work, handling a heavy metal gate. MRI showed a distal biceps rupture with significant retraction, and a small distal triceps musculotendinous tear. At repair the biceps tendon could not be reached with blunt finger dissection; a small proximal incision to the tendon was made. A week post-operatively, the patient removed his own backslab due to discomfort. He also went back to work on 'light duties' limiting lifting to 5 kg. However, two months post-operatively, he re-attended A&E after feeling a popping sensation in his arm. Plain film at that point showed heterotropic new bone formation adjacent to the radial tubersosity and ultrasound was requested to investigate whether the bone was within tendon, or whether there was avulsion. USS noted that the ossification was separate to bone, but in continuity with the biceps tendon itself, with proximal tendon thickening and internal vascularity. There was also synovitis in the adjacent bicipital bursa. Myositis ossificans within the pronator teres was diagnosed. The use of USS to accurately delineate bicipital tendon heterotropic bone formation has not been widely discussed, even though there are clear advantages in its use to guide surgical excision.

Ultrasound of bone fractures

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Abstract
Ultrasound has been shown to be more sensitive than X-ray in demonstrating bone fractures. This can be taken advantage of in the diagnosis of non-displaced fractures such as rib, hip, sternum, stress and toddlers' tibial fractures, all of which are not visible using X-ray. The real advantage of ultrasound is that it is globally available, unlike X-ray which is only available to 25% of the World's population. The author presents examples of bone fractures diagnosed by ultrasound with reference to established medical literature.

Physics

Ultrasound metrology at NPL: Past, present and future

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Abstract
The safety assessment of medical ultrasound equipment demands measurement of important safety-relevant acoustic parameters in an objective, standardised and traceable way. This presentation reviews the history of ultrasound metrology at NPL, from its inception over forty years ago. Key developments will be described such the membrane hydrophone, and the commissioning of a primary standard for their calibration, based on a Harwell-developed Michelson interferometer that generated a step-change in uncertainty in relation to reciprocity. Today, many measurements made worldwide on the acoustic output characterisation of diagnostic imaging devices are linked to the NPL primary standard, providing traceability to the SI unit of length. Parallel developments in measurement capability for the other important quantity describing the ultrasound field, acoustic output power, will also be presented. An important route for the dissemination of the ultrasound standards lies in NPL calibration services, particularly for equipment manufacturers, but other mechanisms lay in technical standard contributions through IEC Technical Committee 87. The role of international key comparisons to underpin mutual recognition of measurement capabilities across national boundaries will be described. Other milestones tracing the development of NPL's research activity are the assessment of thermal hazard, cavitation detection, and the study of techniques supporting the development of high-intensity therapeutic ultrasound. The second half of the presentation will review current research activities that are being undertaken as part of the NPL Medical Physics Institute (Memphys). Areas being addressed include hydrophone calibration at increasingly higher frequencies that demand the commissioning of a new, more sensitive, primary standard. A key new thrust area for metrology lies in quantitative imaging, and the formative stages of work to support the clinical application of ultrasound elastography will be described, along with NPL's own phase-insensitive

ultrasound imaging technology. The presentation will present a forward look at developments in metrology in this area.

Is ultrasound safe? That's a definite maybe!

P Verma
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Abstract
This talk will focus on safety issues from the perspective of a clinical scientist working in medical ultrasound. The last decade has seen a rapid increase in the use of ultrasound for clinical diagnosis and therapy. Recent progress and developments in the area of ultrasound safety will be reviewed, including new pulse sequencing technologies such as acoustic radiation force imaging (both p-SWE and 2D SWE), contrast-enhanced ultrasound and plane wave imaging, and therapeutic technologies such as HIFU and ESWL. Specific areas of clinical application such as obstetrics, gynaecology and neonatal ultrasound will be covered. Issues related to transducer repair and their implications for safety will also be discussed. Guidelines from various international and national bodies will be discussed. A broad overview of selected published literature will be presented covering topics such as the usefulness of safety indices, the relaxation of acoustic output restrictions and user awareness of ultrasound safety.

Cosmetic ultrasound – The exciting world of body sculpting and skin tightening

B Ward
Northern Medical Physics and Clinical Engineering, Freeman Hospital, Newcastle upon Tyne, UK

Abstract
Over the last 10 years or so, several different cosmetic ultrasound devices have been developed and approved for sale in Europe and the USA, mainly for body sculpting and skin tightening applications. Of these, the most widely used in the UK are probably: (a) the Solta Medical 'VASERlipo' device, operating at 36 kHz, and used in ultrasound-assisted liposuction, i.e. an invasive form of body sculpting; (b) the Syneron Candela 'UltraShape' device, operating around 200 kHz, and used for non-invasive body sculpting, e.g. the reduction of fat around the waist; (c) the Solta Medical 'Liposonix' device, operating at 2 MHz, again used for non-invasive body sculpting – a 'high-intensity focused ultrasound' technology; (d) the Merz Aesthetics 'Ulthera' device, operating at 4 or 7 MHz, used for non-invasive skin tightening, e.g. around the neck – another 'HIFU' technology. In this talk, these four devices and the technologies behind them are described. In addition, the 'clinical' effectiveness and safety profiles of the devices are outlined, the number of private clinics in the UK using them is estimated, and the regulatory framework governing their use in this country is briefly considered.

High frame-rate triplex cardiac imaging using diverging waves

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Abstract
Using ultrasound to decipher interconnections between myocardium motion, vortex dynamics in the left ventricle (LV) and microbubble-assisted myocardial perfusion, could be of clinical use for the early diagnosis of cardiac dysfunction. However, obtaining this information simultaneously is not possible using commercial systems, limited by a low frame rate due to the typical line-by-line scanning mode. Recent engineering advances in research ultrasound platforms have opened avenues for better understanding of cardiac dynamics through high frame rate (HFR) imaging. By transmitting unfocused diverging waves (DWs), a B-mode frame can be reconstructed from a single DW transmission by parallel beamforming. This approach can achieve frame rates up to 10 kHz, which is an order of magnitude faster than most clinical scanners. The image degradation due to the lack of transmit focusing when using DW can be alleviated by coherent compounding of echoes from multiple steered beams. In this study, a triplex cardiac imaging technique, i.e. B mode, contrast mode and 2-D vector blood flow mapping in the LV, was demonstrated with a HFR of 250 Hz by using a research system transmitting DWs. Nonlinear imaging using amplitude modulation (AM) (2.78 MHz, MI 0.12) was considered for contrast echocardiography, specifically highlighting nonlinear signals of the SonoVue microbubbles. This study demonstrated that with the same pulse sequence, B-mode imaging, contrast-mode imaging and 2-D vector blood flow

mapping could be obtained simultaneously at a frame rate of 250 Hz by transmitting DWs.

Education Stream

Quality vs. quantity: What makes a good clinical training experience

F Sadak
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Abstract
In 2015, a group of regional leads representing hospitals from across the Wessex region were deeply concerned about the shortages within the sonography workforce. Many departments were experiencing an increase in workload, were heavily reliant on locums and facing a future where 40% of the sonography workforce were eligible to retire. In an overstretched service, training was and is a challenge and an overwhelming experience for the trainees. The concept of the Wessex Regional Training Programme was developed. Three ultrasound trainers in obstetrics and gynaecology were recruited with the objective to deliver a high-quality training programme, increase training capacity and importantly and improve the training experience. Health Education Wessex provided funding for two posts and University Hospital Southampton NHS FT funded one substantive post. This talk discusses how the role of the regional trainers has developed over the last two years, the achievements of the programme as well the challenges in developing a training programme for the region. Our aim was to support the traditional post-graduate trainees as well as supporting additional trainees undertaking the Short Focus Ultrasound Course in Fetal Growth Scan which the ultrasound departments were unable to support. We found that training was varied across the region and felt a standardised approach was crucial. There is no short-term fix in solving the shortages within the profession and establishing a full complement of sonographers within ultrasound requires time, dedication and commitment. This is where the role of the regional trainers has been effective in offering a positive training experience. Our vision is to develop a Wessex Ultrasound Training Academy providing a high-quality training programme with the regional trainers continuing to support the trainees in their clinical departments.

Poster Exhibition 2018

Breast

Breast pathology – Early diagnosis by ultrasound

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Abstract
Ultrasound is a non-invasive, low-cost technique, does not use ionizing radiation and is a "real-time" image, and for these reasons, this method is first-rate in several situations. The purpose of this study was to demonstrate breast ultrasound evaluation as a first-line diagnostic method and to evaluate the variation of the breast characteristics along the age. A total of 105 women with a mean age of 30 years participated, divided into three age groups: 18–39, 40–59 and 60–79 years, excluding participants subject to mastectomy. After completing the informed consent, all participants answered personal and sociodemographic questions, such as personal and family history, menstrual cycle, pregnancy, ultrasound and mammography, among others. They were then submitted to a bilateral breast ultrasound examination. Subsequently all the images and their data were analyzed and a technical report of the examination was given to all the participants. A total of 105 women with a mean age of 30 years participated, 58 of whom underwent the examination for the first time. In 31, changes (of which only 7 were known) were diagnosed. It was verified that, according to the age group, the breast stromal density varied, being that in the women with greater age this presented lower density. Ultrasound is a good method for breast evaluation and can be considered important for the early evaluation of breast pathology and follow-up of the pathology.

General Imaging

Ultrasound in developing countries

D Denniss
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Abstract
Over the past 15 years, I have been involved in several projects and relief work as a sonographer and

radiographer in developing countries; the Amazon jungle of Ecuador (1 year), the Andes Mountains in Peru (several visits), Uganda and Ghana. A total of 1.2 billion people in the world live in poverty and many people in the developing world die from curable diseases. Ultrasound has a key role in the diagnosis of many of these diseases and is an essential tool, especially in the absence of other imaging modalities like CT and MRI. Drawing on personal experiences and literature, the aim of the poster is to discuss the role and challenges of ultrasound in the developed world using photographs, case studies and ultrasound images. This poster discusses: working with old or poorly functioning equipment; the challenges of teaching ultrasound (and un-teaching old/poor technique!); common and unusual pathologies including infectious tropical diseases; scanning and reporting in a foreign language; challenges and rewards of living in a developing country. Ultrasound is a highly useful imaging modality in the developing world. Working in other countries can provide huge benefits to local populations and can improve knowledge, skills and experience for both the community and the individual sonographer.

Case report: Soft tissue lumps – A case of thrombosis of the deep dorsal vein of the penis

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Abstract
There are many case reports of thrombosis of the superficial dorsal vein of the penis, but thrombosis of the deep dorsal vein of the penis is much more unusual. Ultrasound for soft tissue lumps is commonplace in every radiology department and a case such as this could cross any sonographer's list. This case study will document a spontaneous presentation of venous thrombosis of the deep dorsal vein of the penis, presenting as a palpable lump via the general practitioner and document pictorially the differentiating factors. We report the clinical and ultrasound findings and discuss the functional and therapeutic issues related to the condition and its differentials of superficial dorsal penile vein thrombophlebitis (Mondors disease). There are reported relationships with thrombophilia and trauma, but spontaneous thrombosis is rare. While no therapy is required for superficial vein thrombosis, unless there are other risk factors for venous thromboembolism, complete or segmental penile thrombosis has been treated with fibrinolytics and anticoagulation. The deep vein drains the glans, corpus spongiosum and distal two-thirds of the corpora cavernosa. A relationship between deep vein thrombosis and deep penile thrombosis seems logical and anticoagulation, as for these disorders, may be applicable to deep penile vein thrombosis. To date there have been few reports of spontaneous thrombosis of the deep dorsal penile vein and no treatment recommendations.

Retrospective analysis to assess the diagnostic value and accuracy for characterisation of focal lesions with contrast-enhanced ultrasound

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Abstract
Contrast-enhanced ultrasound (CEUS) was developed to overcome the limitations of conventional Doppler and B-mode ultrasound and to utilise the enhancement characteristics of focal liver lesion which are more traditionally assessed using CT and MRI. In recent years, there has been significant experience gained as well as technological improvements, in this technique. The aim of this study was to assess the local diagnostic accuracy for characterisation of focal lesions using (CEUS) by comparing the findings of those on CT/MRI and histology. A retrospective analysis was carried out of all patients in the authors' centre who had CEUS studies to characterise focal liver lesions. These studies were performed between January 2014 and December 2016. The CEUS results were compared to the findings from tissue diagnosis and CT/MRI characterisation. A total of 333 CEUS studies were analysed – 291 of these offered a definitive diagnosis, (192 benign lesions and 109 malignant lesions were identified.). Of the 291 conclusive studies, 125 had further subsequent histological and radiological characterisation (CT + MRI). The positive predictive value = 90% and the negative predictive value = 95%, with a sensitivity of the CEUS findings concurring with further imaging and histology of 97% and a specificity was 84%. In this study, CEUS demonstrated an excellent specificity and sensitivity for the detection of focal lesions. CEUS, when technically feasible, can be used as a surrogate for CECT and CEMRI in the assessment of focal liver lesions and it can play a fundamental role in their identification and characterisation, reducing the need for re-appointment,

delays and specialist referral. CEUS offers a highly cost effective option for the characterisation of straight forward lesions such as haemangiomas.

Ultrasound evaluation of obstructive jaundice in patients presenting to a 'one-stop' jaundice clinic. A retrospective audit in a single centre

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Abstract
The initial evaluation of obstructive jaundice involves distinguishing intra- and extra-hepatic biliary obstruction. The goal of any radiologic procedure in obstructive jaundice is to confirm the presence of biliary obstruction by detecting biliary dilatation, identify the location and extent of the obstruction and to identify the probable cause of the obstruction. Ultrasound is readily available and does not use ionising radiation and is therefore used as a first-line investigation for jaundice within our unit. The efficacy of ultrasound in the evaluation of obstructive jaundice is highly variable within the literature. Ultrasound is able to distinguish between obstructive and non-obstructive jaundice in approximately 90% of cases. Demonstration of the level and cause of jaundice by ultrasound varies within the literature but should be established in around 60% of cases. The aim of this study was to determine the proportion of patients presenting with obstructive jaundice who have the level and cause of jaundice established on preliminary ultrasound. Patient selection for this audit will be those patients who have previously presented to the 'one-stop' jaundice clinic within our institution. The reference standard will be the results of other imaging (MRI, CT, ERCP) and review of patient medical records. The ultrasound reports of patients included within the audit will be retrospectively reviewed and compared with subsequent imaging/patient records to determine the number of patients in whom the cause of jaundice was correctly established by ultrasound. Ultrasound is expected to correctly determine the cause of obstructive jaundice in 60% of cases. The audit is ongoing. We will present the results during this poster presentation.

Imaging complications in orthotopic liver transplantation with Doppler ultrasound: A pictorial review

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Abstract
Liver transplantation is the main treatment for end-stage liver disease. Operator awareness of ultrasound features of post-transplantation complications is vital to graft survival. Clinical presentations and laboratory findings of graft complications are often non-specific, heralding the use of ultrasound as the first-line imaging modality in the serial monitoring of these liver allografts. This pictorial review aims to: (i) illustrate the normal post-transplantation imaging findings; (ii) demonstrate post-transplantation complications and their imaging characteristics. Orthotopic post-transplantation cases performed in Singapore General Hospital were evaluated using ultrasound B-mode and colour Doppler imaging. The sonographic appearances of a normal post-transplantation liver and a spectrum of cases to demonstrate the possible post-transplantation complications will be presented. These cases will be classified into three categories, namely vascular, biliary and others. Ultrasonography plays a pivotal role in the postoperative diagnosis and management of orthotopic post-transplant recipients. Understanding the imaging spectrum of normal and abnormal conditions is essential in the early diagnosis of liver transplant complications to improve patient outcome by allowing prompt and timely management.

Overlooked bladder pathologies in transabdominal ultrasound examinations

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Abstract
Transabdominal ultrasound examinations are a routine investigation in the management of surgical patients with acute abdominal or pelvic pain. The bladder is often imaged purely to measure residual urine volumes or used as a window for interrogation of the ovaries and uterus. However, there are a range of important pathologies that may be overlooked

unless the bladder is specifically examined as an organ itself. This retrospective pictorial review of patients presenting with acute abdominal pain or urinary symptoms in a tertiary centre demonstrates the range of bladder pathologies that may be missed during transabdominal ultrasound examinations. This imaging review includes a range of bladder pathologies that were encountered during transabdominal ultrasound urinary tract examinations, including urachal cysts, ureteroceles, emphysematous cystitis, fistulae, calculi and a range of tumours. We also review best practice for ultrasound examination of the bladder to minimise the risk of false negative examinations. Ultrasound evaluation of the bladder should not be dismissed as purely for assessing residual urine volumes or as a 'window' for examination of the pelvis. Instead, dedicated examination of the bladder is required during ultrasound evaluation of the urinary tract or during routine transabdominal ultrasound examinations. Those undertaking ultrasound in patients with abdominal-pelvic pain or urinary symptoms should possess an understanding of potential bladder pathologies in order to accurately diagnose them and expedite management.

Case report: Testicular rupture – A force of 50 kg

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Abstract
This poster displays the application of ultrasound in the diagnosis of testicular rupture. A 27-year-old male presented to the ED with left testicular pain, 72 hours post-blunt testicular trauma sustained during football training. Testicular rupture, one of the most common complications of blunt testicular trauma, is the rupture of the tunica albuginea and extrusion of testicular parenchyma. A force of approximately 50 kg is required to rupture the tunica albuginea. Patients clinically present with testicular swelling, tenderness and severe pain. Many studies have reported testicular ultrasound to be fast and reliable in differentiating a broad range of time-sensitive pathologies, including testicular torsion, fracture, and rupture. Sonographic findings demonstrated an enlarged, heterogeneous left testicle with disruption of the tunica albuginea indicating testicular rupture. There was an irregular contour of the left testicle and evidence of intra-testicular haematoma on B-mode imaging. The lower pole demonstrated absent perfusion on colour Doppler, providing useful information to the surgeon regarding the extent of debridement. Ultrasound has a sensitivity of 100% and specificity of 65% in the detection of testicular rupture. Current management of testicular rupture is surgical exploration and repair, or orchiectomy. Prompt surgical intervention is critical in preventing testicular loss. When presentation occurs within 72 hours of injury there is a 90% salvage rate, this is reduced to only 30% salvage rate after 72 hours. Ultrasound is the modality of choice for the evaluation of blunt testicular trauma due to its high sensitivity and efficiency in assessing the integrity of the testis and vascular perfusion. Ultrasound findings can guide the physician in determining optimal treatment. Testicular rupture requires early surgical intervention to improve testicular salvage rates. Ultrasound was paramount in the diagnosis of testicular rupture in this case.

Ultrasound guided malignant ascites drainage – A unique multi-professional approach

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Abstract
During 2007 to 2008, malignant ascites accounted for over 28,000 bed days in hospital in England (HES statistics). There is no evidence in favour of any specific drainage technique; however, malignant ascites drainage is most commonly performed on day-case or inpatient basis. Patients often wait until fluid accumulation is substantial to avoid frequent hospital stays, resulting in a deterioration of their quality of life.[1] The Radiology Department at GWH wished to address this issue aiming to improve End of Life (EOL) care. A self-referral out-patient malignant ascites drainage service was introduced, enabling the patient to contact the Radiology Department directly and arrange an appointment at their convenience. In order for the service to be flexible, it has seen the successful training of both nursing and sonography colleagues to perform ultrasound guided paracentesis using aseptic non-touch technique. There is paucity of reliable evidence regarding the optimum method of managing malignant ascites either at initial presentation, during treatment or palliation.[2] At the GWH, the service involves ultrasound guided siting; the ascites is then manually drained by

syringe before removal of the cannula, this requires the patient to be in the department for only a few hours. The service offers an improvement in end of life care by being flexible, efficient and personable. The outpatient service reduces patient time in hospital resulting in a decrease in exposure to healthcare acquired infections. The estimated cost of day patient paracentesis was £954, compared with £1473 for in-patient paracentesis. The estimated cost to perform ultrasound guided malignant ascites drainage with mechanical aspiration is approximately £805. This results in a saving of £668 per patient. The impact on hospital wards or day case units is also reduced.

References

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Case report: A case study of carotid artery skull base dissection – US clues suggesting distal pathology

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Abstract

A 51-year-old patient was admitted with left-sided weakness and numbness and headache. An MR brain scan was performed revealing right hemisphere multiple infarcts. A carotid ultrasound was then requested which demonstrated bilateral internal carotid artery (ICA) luminal filling but very low velocities compared to the common carotid arteries (CCAs). Additional imaging was therefore suggested. A carotid MR demonstrated bilateral ICA abnormal luminal narrowing centred at the junction with the skull base with mural haematoma consistent with bilateral ICA dissection.

Falling off the cliff: Renal resistive index as a pre-procedural predictor of acute kidney injury risk. A critical review

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Abstract

Doppler renal resistive index (RRI) has been established as a useful prognostic indicator for renal recovery in critical care patients with confirmed acute kidney injury (AKI). In recent years, a small number of studies have emerged that consider pre-procedural measurement of RRI as a predictor of AKI in patients following major surgery and prediction of contrast induced AKI. These findings may have significant implications for patient management prior to contrast-enhanced imaging procedures, assessment of pre-procedural risk and patient counselling prior to surgical intervention. This poster presents a critical review of relevant studies.

Ectopic splenic tissue, the value of contrast-enhanced ultrasound

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Abstract

Two forms of ectopic splenic tissue are recognised: splenosis and accessory spleens. Both are often discovered as incidental findings and commonly pose a diagnostic dilemma due to their ability to mimic more sinister pathology. As splenic tissues have a characteristic sonographic appearance when ultrasound contrast microbubbles are administered, ultrasound is a valuable tool in confirming the diagnosis. Unfortunately, it is often underused. This poster will demonstrate a series of cases of ectopic splenic tissues and give an overview of the classical diagnostic features, paying particular attention to their sonographic appearance with contrast ultrasound. It is hoped that the poster will help to educate the reader as to the benefits of contrast-enhanced ultrasound in such cases, and how this can help to avoid investigations with an ionising radiation burden and unnecessary surgical interventions.

Gangrenous cholecystitis: Does contrast-enhanced ultrasound improve diagnostic accuracy? A systematic review and meta-analysis

S Smith
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Abstract

Gangrenous cholecystitis is the most common complication of acute cholecystitis with associated high mortality rates. Clinical detection is poor due to unspecific clinical/laboratory findings. Computed tomography (CT) is the imaging gold standard for pre-surgical detection; however, it involves ionising radiation and delayed diagnosis. This review aims to compare diagnostic accuracy of CEUS to cholecystectomy for detection of gangrenous cholecystitis pre-operatively. A systematic search of electronically published literature identified 1226 studies. Two studies met the inclusion criteria and one study was further identified by hand-searching reference lists of potential studies. Three studies were included for analysis. Study quality was assessed using QUADAS-2, data extraction performed, followed by meta-analysis. Three prospective cohort studies with a total of 233 patients were included. All studies had moderate-high methodological quality. Pooled sensitivity and specificity for contrast ultrasound was 83% (76–89% 95% CI) and 86% (77–89% 95% CI). Ultrasound diagnosed 12 false positives, 5 due to perforation, the remainder not specified. There was a total of 25 false negatives. The sensitivity and specificity of contrast ultrasound are comparable to those of computed tomography; therefore it is feasible to use as a non-ionising alternative. However, further research is required to determine the economical implication of departments learning a new technique.

Ultrasound assessment of early chronic liver disease

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Abstract

Liver disease is an increasing problem world-wide and liver disease is the only major cause of death still increasing year-on-year. Liver disease often starts with fatty infiltration of the normal liver tissue. Left untreated this can progress to fibrosis and cirrhosis. Severe cirrhosis can lead to the development of hepatic cellular carcinoma and a very poor prognosis. Often, the process is silent, but when liver disease has developed and presents as an acute illness it has a 25–50% immediate mortality rate. Commonly, the first diagnosis of liver disease is through ultrasound imaging where the increased fat in the liver is detected. Ultrasound imaging is a relatively cheap and simple first line investigation. Significant fatty infiltration can be diagnosed. However, it can be very difficult to determine the extent of fatty infiltration and therefore the significance of this. This can lead to an under or over diagnosis of this common but potentially life changing condition. New machine technologies have helped in lesion detection but the traditional diagnostic features of ultrasound imaging that aided diagnosis of fatty liver disease have changed these parameters. This has led to an inconsistency between ultrasound operators in their diagnosis of fatty liver disease. The aim of this project is to evaluate the agreement between operators in the diagnosis of fatty liver disease. Twenty-five sets of images of previously reported fatty livers were reviewed retrospectively. Twenty operators with a range of experience from 1 to 30 years scored the images. The scores will be compared and any variability between reviews will be assessed. This poster presents the results of this local inter- and intra-operator review of this common but significant finding.

Analysis of A-line patterns seen on lung ultrasound scans in healthy volunteers following spontaneous breathing and high-flow nasal cannula therapy

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Abstract

A-lines are a type of ultrasonographic artefact seen as horizontal lines arising at regular intervals from the pleural line. The presence of A-lines can either be a variant of normality or pathological conditions like pneumothorax. Currently, there is a lack of guidelines and recommendation about the usage of A-lines analysis in the diagnosis and monitoring of respiratory conditions. This study is designed to determine whether hyperinflation of the lungs results in a difference in the number and echogenicity of A-line artefacts on lung ultrasound scans. We performed a prospective before-and-after trial on 37 healthy volunteers. Lung ultrasound scans were performed before and right after 15 minutes of high-flow nasal cannula (HFNC) air therapy, which was used to increase the end-expiratory volume of the lungs to create a state of hyperinflation. Two variables were analysed: the number and echogenicity of A-line

artefacts. Changes in the number of A-line artefacts before and after HFNC were analysed using a paired t-test. Out of 37 healthy participants, 28 showed a significant increase in the number of A-lines (1.27, 95% CI: 0.82 to 1.72, $P < 0.0001$) after 15 minutes of HFNC. Conversely, a majority 51.4% of participants (19 participants) showed no changes in echogenicity. However, a two-sided P value of $P = 0.0127$ ($P < 0.05$) obtained using a sign test indicates that if there is any change, it is more likely to be an increase in echogenicity. Since hyperinflation of the lungs results in a significant increase in the number of A-lines, lung ultrasonography has the potential to be used as a point of care tool for the monitoring of the degree of inflation of the lungs, and thus the severity of chronic obstructive pulmonary disease (COPD) and asthma attacks. It can also be used in the monitoring of mechanical ventilation and prevention of ventilator-induced lung injury (VILI).

Gynaecology

Classifying ovarian masses using IOTA – A retrospective study

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Abstract
Management pathways for ovarian masses can be complex and differ greatly from patient to patient. Description of an ovarian mass in an ultrasound report is often lengthy and superfluous providing no clear direction to the consultant gynaecologist or the multi-disciplinary team. Currently, NICE states 'There is currently not enough evidence to recommend the routine adoption of the IOTA ADNEX model, Overa (MIA2G), RMI I (at thresholds other than 200 or 250), ROMA or IOTA Simple Rules in secondary care in the NHS to help decide whether to refer people with suspected ovarian cancer to a specialist multidisciplinary team (MDT)'. NICE indicates that the IOTA simple rules and descriptors show promise but more research is required on test accuracy and the impact of test results on clinical decision making. We carried out a retrospective audit. A Computed Radiology Information System (CRIS) search using the key words 'ovarian mass', 'ovarian malignancy', 'ovarian tumour' over a two-year period returned 215 results. Comparison between the IOTA classification and histology was performed. Ninety-four ovarian masses were suitable for retrospective IOTA classification. Simple descriptors could be used for five cases. Four cases were excluded from the study. The remaining 85 cases were classified using IOTA simple rules. Two experienced sonographers reviewed the cases and classified the ovarian masses using the IOTA guidelines. There were $n = 84$ correct classifications. Of these, 11 were unclassified (benign at histology) and 1 was unclassified (malignant at histology). One was classified as malignant (benign at histology). The audit was limited by its small sample size, but overall gave encouraging results. Simple rules/descriptors should help us report in a systematic way. This allows for a more consistent, useful style of ultrasound report. The method aids the pre-operative characterisation of adnexal masses which in turn determines the appropriate patient management. However, the method is subjective and operator dependent. Expertise is required.

Predicting endometriosis with transvaginal ultrasound

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Abstract
Ovarian endometriomas are the most common feature of endometriosis identified on transvaginal ultrasound (TVUS). However, identifying additional features associated with endometriosis can improve prediction and with adequate training diagnostic accuracy with TVUS can be achieved. This poster examines various ultrasound features and techniques that can be used to diagnose endometriosis with ultrasound, including 'soft markers'.

What is the diagnostic accuracy of 3D ultrasound in comparison to MRI for uterine anomalies?

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Abstract
Congenital uterine anomalies (UAs) have a higher incidence in women with infertility or recurrent miscarriage with septate uteri associated with the poorest outcomes.[1] The lack of a standardised approach for diagnosing and classifying UAs has been widely recognised with examinations including

two-dimensional ultrasound (2D US), three-dimensional ultrasound (3D US), hysterosalpingography (HSG), magnetic resonance imaging (MRI) and laparoscopy/hysteroscopy.[2] The aim of the review was to determine the accuracy of 3D US in comparison with MRI, the current imaging gold standard, in the characterisation of uterine anomalies. Studies performed after 2006 were identified using a comprehensive Ovid search. Comparison of 3D US and MRI with hysteroscopy/laparoscopy as the reference standard shows that the most accurate procedure for the characterisation of UAs is 3D US, with an accuracy of 97.2% to 96% compared with 91.6% to 79% achieved by MRI using the American Fertility Society classification.[3] Comparison of 3D US against MRI diagnosis alone demonstrates good strength of agreement (0.878 95% CI: 0.775–0.980) using the AFS classification and associated anomalies. Using the European Society of Human Reproduction and Embryology-European Society for Gynaecological Endoscopy (ESHRE-ESGE),[4] reported sensitivity of 3D US ranged from 83.3 to 100%, specificities of 88.9 to 100%, positive predictive value (PPV) of 95.5 to 100% and negative predictive value (NPV) of 98.2 and 100%. The accuracy of 3D US in the characterisation of UAs is superior to MRI. Findings of this review support the recommendation that 3D US should be a necessary step to investigate UAs to achieve a definitive diagnosis, eliminating the need for further investigation in the majority of cases. However, a universally agreed classification system incorporating all variations which offers clear descriptions to facilitate diagnosis and treatment planning is urgently required.

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Endometrial thickness – Is there an optimum cut-off value in postmenopausal women with bleeding?

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Abstract

Endometrial cancer (EC) is the fourth most common gynaecological cancer in the UK. More than 90% of patients with EC present with vaginal bleeding. Transvaginal ultrasound examination, which allows close range magnification and high-resolution imaging, is routinely performed as part of a pelvic ultrasound assessment and is the first approach in evaluating a postmenopausal woman (PMW) with an initial episode of bleeding. There have been debates in the literature on the optimal endometrial threshold separating normal from abnormally thickened endometrium, ranging from 3 to 5 mm. The objective of this literature review was to explore an optimal endometrial thickness cut-off value in non-medicated patients with postmenopausal bleeding for the detection of EC. A literature search of published articles using the University of Derby digital databases was performed to identify articles reporting on EC and endometrial thickness measurements in women with postmenopausal bleeding. Two retrospective studies and a prospective case–control study were reviewed with consideration given to their sample sizes, methodology and the use of statistical analysis. Endometrial thickness was significantly higher in women with EC than without in all three studies. The study with the largest sample size recommends a cut-off value of 5 mm in symptomatic women with postmenopausal bleeding with a sensitivity of 80.5% and a specificity of 85%. A threshold of 3 mm provides a high sensitivity for the diagnosis of EC. However, such a low cut-off value could raise false positive results and can also increase anxiety levels in patients. There is a correlation between thickened endometrium and endometrial cancer. There is no cut off-value that can reliably exclude the presence of EC. Asymptomatic women may have the disease present and it is a factor which cannot be accounted for. However, malignant disease has been reported in endometrium as thin as 1 mm.

Transvaginal ultrasound: Beware the cervical cancer

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Abstract
Cervical cancer is a preventable disease; around 3000 cases are diagnosed each year in the UK. Approximately 75% of cervical carcinomas are diagnosed following an abnormal cervical smear, with subsequent clinical examination and biopsy. However, with the advent of one-stop clinics for abnormal per vaginal bleeding, patients can present for a transvaginal ultrasound (TVS) prior to clinical examination, and a recent smear may not have necessarily been performed. When performing TVS for abnormal bleeding, the sonographer is correctly concentrating on the endometrial appearances, which will not be apparent clinically. However, cervical abnormalities should not be overlooked. We propose that it is of paramount importance to ensure that the cervix is routinely adequately imaged on all pelvic ultrasounds (both transabdominal or transvaginal) for all clinical presentations. The sonographer should be aware of assessment of the cervix, and be familiar with the normal appearances, as well as the ultrasound findings in the context of carcinoma of the cervix. The reporter should then be able to signpost the referrer to the next appropriate step in investigation. We present the normal appearances of the cervix on TVS and four cases of histology-proven carcinoma of the cervix, three with initial presentation at ultrasound. Two cases were thought to have endocervical polyps, the third was suspected on ultrasound and the fourth seen in retrospect on ultrasound. Transvaginal ultrasound and MRI images are demonstrated to illustrate both normality and the varying appearances of cervical cancer.

A day in the life of a fertility sonographer

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Abstract
This poster describes the role of the sonographer in a dedicated fertility clinic, with discussion around the variety of scans, as well as the emotional support provided to the patient and their family. The aim is to help sonographers based in hospitals without fertility units but who receive scan referrals from general practitioners or gynaecologists for patients with fertility issues and to give an insight into the journey a patient has experienced prior to their dating and anomaly obstetric scans. It discusses the baseline gynaecological scan, which includes baseline transvaginal 2D and 3D ultrasound scans to ascertain a normal uterus and ovaries along with an antral follicle count (follicles between 2 mm and 10 mm). The scan findings should correlate with the stage of the patient's cycle and exclude pathologies. Treatment scans are used to monitor ovarian follicles with 3D technology. We describe the monitoring of endometrial thickness and the role ultrasound has to play in the thin endometrium by assessing the Resistive Index of the uterine arteries. We discuss the role of the sonographer as the patient prepares for an embryo transfer, the emotional support as well as trans-abdominal scanning to assist the transfer of the embryo by the gynaecologist. We describe the highs and lows of the early pregnancy scan usually performed around 7 weeks' gestation. Trans-abdominal scans are performed after 10 weeks' gestation prior to a blood test. In the male patient, we provide ultrasound assessment of the testes to exclude testicular masses, abnormal vascularity and varicocoele in the Andrology Department. Case reports include sample images of 3D colour antral follicle count of an ovary, 3D colour view of a stimulated ovary and subsequent report graph as well as images of 3D endometrial cavities including anomalies.

Pitfalls of female pelvic ultrasound imaging Is it really what you think it looks like?

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Abstract
Ultrasound imaging is a key diagnostic tool of modern clinical diagnosis. It is also an important source of diagnostic errors that can have a major impact in patients' management and treatment. Is the anechoic structure with thin walls actually the bladder or is it an ovarian cyst that needs drainage? Are there echoes or septa in the fluid filled structure? Is it sinister or a benign structure? It is easy to convince yourself a structure is a particular structure because it is where you expect it to be and the sonographic appearance is as you would expect for the structure. We would like to demonstrate some of the near misses we have experienced when performing pelvic gynaecological ultrasound and by doing this provide a reminder of how certain structures can have similar sonographic appearance. The misdiagnosis or incorrect diagnosis of certain structures can have a significant impact on a patient's morbidity and mortality.

3D TV ultrasound congenital uterine anomalies

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Abstract
Transabdominal (TA) and transvaginal (TV) ultrasound is the routine imaging modality of choice for assessing the female pelvis. The advent of three-dimensional TV ultrasound in gynaecological examinations is proving a useful adjunct when assessing the female pelvis. Congenital uterine anomalies affect 3–8% of women. These anomalies are not typically associated with infertility but are associated with adverse reproductive outcomes such as pregnancy loss and preterm delivery. Three-dimensional transvaginal ultrasound of the uterine cavity is extremely accurate in diagnosing and classifying anomalies. In current practice, the most universally recognised classification systems for uterine anomalies are the ESHRE/ESGE and AFS classifications. The aim of this poster is to demonstrate three-dimensional TV ultrasound appearances of congenital uterine anomalies.

Head and Neck

The role of elastography in the assessment of thyroid nodules and its future direction

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Abstract
Ultrasound (US) assessment of the thyroid is becoming increasingly in demand, with the prevalence of thyroid nodules being estimated at 67% of the population.[1] Currently, US assessment through B-mode scanning with a view to fine-needle aspiration biopsy (FNAB) is considered the gold standard in thyroid nodule characterisation.[2] However, the non-invasive evaluation of tissue stiffness through elastographic assessment is trying to change this. Several studies have shown elastography to have a significant role in the accurate discrimination of benign lesions from malignant,[3–6] allowing for both quantifiable and qualitative thyroid nodule assessment. High-sensitivity and specificity values of 98.5% and 99.8%, respectively, have been noted when elastography is combined with B-mode US, suggesting a potential decrease in the need for FNAB of up to 34%.[7,8] Nevertheless, utilisation of elastography to guide FNAB to increase cytopathological effectiveness has also been documented as a step forward. The role of thyroid elastography may also be extended into a surveillance capacity for negative FNAB nodules.[9] Future advances should include establishing a solid role for elastography in a clinical setting, and that of uniform standardisation of elastography grading criteria by way of converting B-mode and elastographic results into an estimate of malignant risk. This work aims to demonstrate the current and future role of elastography in the assessment of thyroid nodules.

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Evaluation of thyroid nodules – Review of agreement between U grade and TI-RADS scoring tools in a single ultrasound unit

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Abstract
British Thyroid Association guidelines recommend the use of U grade for evaluation of thyroid nodules. An initial department review had been performed of 50 thyroid ultrasound studies where thyroid nodules

were assessed, looking at the reporting styles. This identified that rather than consistent use of the U grade, there was a broad range of reporting styles, with most reporters using a descriptive approach and occasional use of U grade by some reporters. Two reporters occasionally used the TI-RADS scoring system. To provide more consistent reports for referring clinicians, this study sought to assess the level of agreement between the U grade and TI-RADS tools by our reporters, and to assess inter-observer agreement for each tool and agreement between tools. Eight experienced reviewers independently assessed the same images of 10 thyroid lesions and provided a U and TI-RADS score based on that imaging. Intraclass correlation was used to assess agreement between reviewers. Kappa analysis was used to assess agreement between scoring systems. There was a high degree of agreement between raters using both the U grading (ICC 0.7; 95th CI: 0.48–0.89) and TI-RADS scoring systems (ICC 0.75; 95th CI: 0.55–0.91). There was no significant difference in inter-rater agreement between the scoring systems. There was also a high degree of agreement between the U and TI-RADS scoring systems ($K = 0.84$; $SE = 0.14$). There is a high degree of inter-rater agreement in use of both the U and TI-RADS scoring systems. There is also good agreement between the U and TI-RADS scoring systems. There is no evidence in our department to promote one scoring system over another. Individual ultrasound units should agree a single scoring system by consensus with their surgical colleagues.

Case report: The role of ultrasound in a diagnostically challenging case of tuberculosis cervical lymphadenitis

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Abstract
Tuberculosis cervical lymphadenopathy (TCL) is the most common extrapulmonary presentation of tuberculosis. The treatment of TB is burdensome and prolonged so a definitive diagnosis or a very strong index of suspicion is needed to warrant commencement of treatment. On initial presentation the patient had no history or clinical features other than an intermittent unifocal neck swelling to raise a suspicion of TCL. Initial imaging was inconclusive for cause of the swelling, antibiotic therapy was provided and the swelling subsided. On second presentation the ultrasound identified features consistent with TCL and along with ultrasound guided biopsy aided diagnosis. B-mode and colour Doppler scanning were used to characterise the swelling. The initial US identified an avascular predominantly hypoechoic lesion with a couple of hyperechoic internal flecks. A pharyngeal pouch was considered a possibility but was ruled out on contrast-enhanced CT (CECT). Retrospectively the appearances could be equated to Stage 3 TCL and the formation of a TCL cold abscess. On second presentation the ultrasound features were classic for 'Collar Stud' cold abscess (Stage 4 TCL) and contained bright flecks of hyalinosis within the caseous contents of the collection and an echogenic wall due to granulomatous inflammation, all highly indicative of TCL. The TCL reached Stage 5 and sinused to the surface whilst the patient was awaiting US guided biopsy. The lesion retained the 'Collar Stud 'outline but appeared more homogenously hypoechoic at time of biopsy due to the prior discharge of the caseous contents through the sinus. The unifocal nature of this case of TCL and the timing of the initial presentation did not yield ultrasound findings highly specific for the TCL. However, the second ultrasound characterised the lesion as highly suspicious for TCL (Stage 4) and prompted the US-guided biopsy for confirmation of the diagnosis.

MSK

Sonographic assessment of calcific deposit volume in rotator cuff calcific tendinosis – A reliable, accurate and non-invasive technique

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Abstract
The aim of this study was to accurately determine calcific deposit volumes in the rotator cuff tendons (RCT), in order to plan radiological-based therapeutic intervention. Upon initial plain film assessment, sonographic evaluation of the calcific deposits (CDep) was performed. Thirty-one ($n = 31$) consecutive patients, with CDep in the RCT, detected on plain films, were referred for radiological therapeutic intervention, within a one-year interval. Twenty-three ($m = 23$) female patients and eight ($n = 8$) male patients were included in the study cohort. The age range was 33 to 71 years with a median

age of 52. Three dedicated MSK radiologists assessed the patient's calcific deposits volume with high-resolution ultrasound, to determine the best treatment option (barbotage, fenestration or a combination of both). Sonographic evaluation of the CDep in the RCT reveals a constant plain film underestimation of the deposit size, in all of our patients. In two patients (k = 2), CDep suspicion on X-rays was sonographically confirmed. The measured difference in two-axis determination of the CDep varies from 3 mm to 5 mm (mean value of 4 mm), with a projected volume underestimation differential of at least 3.9 mm. Sonographic assessment of CDep in the RCT is accurate, non-invasive and rapid. It has significant advantages over plain films (underestimate CDep), CT (invasive) and MR (lengthy, non-reliable) and allows one stop Radiological Intervention.

Ultrasound of full-thickness tears in the supraspinatus tendon: Does patient position affect tear size?

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Abstract
As ultrasound is now the primary investigation in the assessment of shoulder rotator cuff tendons, it was decided to see how patient positioning may affect the measurements obtained when assessing a supraspinatus tear. In the assessment of the supraspinatus tendon, two positions are used: the Crass and Modified crass position. Looking at supraspinatus tears using both these positions this study will compare and determine whether there is any significant difference in the measurements obtained. Thirty-five patients had an ultrasound of their rotator cuff tendons on either the Rt or Lt shoulder. An assessment of the supraspinatus tendon was made using both the Crass and Modified Crass position. If any tears were diagnosed, measurements in both positions were taken in both sagittal and transverse planes. Fifteen patients from the cohort demonstrated either a complete full thickness tear or an incomplete full thickness tear of the supraspinatus tendon. No significant difference was seen between the size of the tears in the Crass position or the modified Crass position in the transverse plane; however, a slight difference was noted between the Crass and modified Crass positions in the sagittal plane, where the tear was seen to measure larger with the modified Crass position. Ultrasound reliably detects supraspinatus tears. Both the Crass and modified Crass positioning are used in the assessment of the tendon but the position used can vary from sonographer to sonographer, although the modified Crass position is deemed as more reproducible. However, as measurements of supraspinatus tears are seen to vary between both positions in the sagittal plane, further studies would be to look at how this may affect the management of a patient and to compare results with surgical findings to decipher which position gives the most accurate result.

Obstetrics

The inconspicuous and the obvious: Spontaneous heterotopic pregnancies

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Abstract
Heterotopic pregnancy is a rare condition, more commonly seen in populations at risk for ectopic pregnancy or those undergoing fertility treatments compared with spontaneous conceptions. Heterotopic pregnancy is the simultaneous coexistence of an intrauterine and an extrauterine gestation.[1] Duverney was the first to report heterotopic pregnancy, in 1708, after finding an intrauterine pregnancy during the autopsy of a woman who had died from a ruptured ectopic pregnancy.[2] By 1970, <500 cases had been reported.[3] The incidence for heterotopic pregnancy is calculated using the incidence of fraternal twins and of ectopic pregnancy and multiplying both. The incidence of a heterotopic pregnancy is 1:30,000 pregnancies,[4] and increases with the use of assisted reproductive treatment. The objective of this abstract is to demonstrate the increasing frequency of these pregnancies at our hospital. We carried out a case series review of heterotopic and abdominal pregnancies over a 12-month period in our hospital. In our hospital, there were 8433 births in 2017 and the number of heterotopic pregnancies was five, giving an incidence of 0.06% and there was one abdominal ectopic pregnancy (0.01%). Of note, all of these were spontaneous pregnancies. Abdominal and heterotopic pregnancies appear to be increasing in frequency, and the incidence of heterotopic pregnancy is thought to be about 1 in 2600 pregnancies annually; primarily because of assisted reproduction.[5] These up-to-date figures of occurrence would better reflect the experience in our ultrasound department and the idea of it being an exceptional finding is no longer the case. The diagnosis of a heterotopic pregnancy can be difficult and may be

delayed until follow-up ultrasound scans are performed. The use of serial βhCG is redundant in these cases.[2] It is imperative that there is precise ultrasound examination of the adnexae and Pouch of Douglas even in the presence of a normal intrauterine pregnancy.[6] To improve the detection of heterotopic pregnancy, a high-resolution transvaginal transducer should be used, the technique must be meticulous and the examination performed by an experienced sonographer.

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Cervical assessment – The unusual and unexpected

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Abstract

Cervical assessment is a key part of the screening of high-risk women for preterm birth. In 2015, NICE recommended that high-risk women with a cervical length of less than 25 mm should be offered prophylactic treatment of either progesterone or cervical cerclage to prevent preterm birth. In May 2017, the Rosie Hospital, Cambridge, established a dedicated Preterm Surveillance Clinic for high-risk women. During the first year, we have had some unusual and unexpected ultrasound findings Current literature describes well the standardize technique for cervical length assessment of the typical cervix but there is little published literature about more unusual cervical ultrasound appearances. The aim of this pictorial review is to increase awareness of unusual cervical ultrasound appearances which can make cervical assessment more difficult. These include: asymmetry of the cervix caused by LLETZ (large loop excision of the transformation zone); full dilation Cesarean section scar; uterine didelphis with 'double cervix', low uterine contraction, endocervical polyp, vasa previa, placenta previa. Awareness of these more unusual cervical ultrasound appearances along with good technique will enable accurate cervical assessment and appropriate management of women.

Case report: Prenatal diagnosis of Walker–Warburg syndrome

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Abstract

Dandy–Walker malformation (DWM) encompasses a spectrum of abnormalities, not limited to absence/abnormality of the cerebellar vermis, dilatation of the third and fourth ventricles and enlargement of the cisterna magna. It is associated with profound cognitive and developmental impairments. A 24-year-old attended for a routine anatomy scan at 20 weeks' gestation. She already had a healthy child and her pregnancy so far had been uncomplicated. The anatomy examination showed significant brain anomalies, namely severe bilateral ventriculomegaly of 16 mm and an absent cerebellar vermis. These findings were later confirmed by a foetal medicine specialist and a provisional diagnosis of DWM made. A further ultrasound examination showed worsening ventriculomegaly of 23 mm and anterior ventriculomegaly. The absent cerebellar vermis appeared more pronounced with increased cisterna magna dilatation. MR examination showed a Z-shaped brainstem, small vermis, occipital encephalocele and asymmetric orbital globes. These findings, along with the deterioration of the brain structures on subsequent ultrasound examinations, gave rise to a more accurate diagnosis of Walker–Warburg malformation, a lethal autosomal recessive genetic disorder, the most severe in a group of congenital muscular dystrophy conditions effecting 1:100,000 live births. After consultation with a paediatric neurosurgeon and geneticist, along with worsening deterioration again on further ultrasound examinations, the couple were prepared for the likelihood of neonatal death or a profoundly dependent child. The parents declined pre-natal testing but opted for a post-mortem when the infant died at three months of age. The post-mortem confirmed the prenatal findings. Whilst the outcome of this case could not

have been changed, the pre-natal diagnosis prepared the parents and the multi-disciplinary teams caring for them of an adverse outcome. Also as Walker–Warburg has a high recurrence rate of 1:4, the couple were also counselled on recurrence in subsequent pregnancies.

Case report: Challenges in the diagnosis of secondary abdominal pregnancy – Unusual presentation with anhydramnios

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Abstract
Abdominal pregnancy is a rare form of ectopic pregnancy associated with higher maternal mortality rate than tubal ectopic pregnancies. Ruptured rudimentary horn pregnancy is one of the rarest forms encountered and this case highlights the challenges encountered in dealing with it. A lady presented to foetal medicine in her second pregnancy with anhydramnios at 19 + 5 weeks' gestation, with normal foetal kidneys and bladder. She had one previous emergency caesarean section for footling breech, and the intraoperative notes at that time suggested evidence of bicornuate uterus, with the pregnancy in the right horn. Throughout the third trimester in this pregnancy, she reported persistent lower abdominal pain and MRI at 30 weeks reported didelphic uterus, with the foetus noted in the left horn and possible tracking of fluid outside the uterus. This led to the concern of possible scar dehiscence or possible rudimentary horn pregnancy. In view of this, a planned caesarean section was carried out at 32 weeks that led to the diagnosis of abdominal pregnancy. A unicornuate uterus with only right ovary and tube was noted intraoperatively. The baby was diagnosed with bilateral congenital hip dislocation requiring surgery but was otherwise well. Placental histology confirmed the presence of myometrium, salpinx and ovary in keeping with ruptured rudimentary horn pregnancy. Undiagnosed ruptured rudimentary horn pregnancy in unicornuate uterus is a very rare cause amongst the various causes of secondary abdominal pregnancy. In spite of advances in ultrasound imaging and MRI, these cases are still seen. Even if diagnosed antenatally, counselling and management is difficult in the presence of a live extrauterine pregnancy. Careful assessments of foetus, uterus and adnexa in early pregnancy in cases with uterine anomalies and developing expertise in the use of MRI may enable early diagnosis in these challenging situations.

Sonographer perspectives of breaking bad news in early pregnancy assessment – A literature review

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Abstract
The National Bereavement Care Pathway (NBCP) is being rolled out across NHS Trusts with the aim of improving bereavement care for patients after pregnancy or baby loss. It aims to improve training and support for staff that are breaking bad news; this will include sonographers. The aim of this literature review was to obtain data on the experiences and subsequent impact on sonographers in relation to breaking news of pregnancy loss. The findings will contribute to improving patient experience by focusing on providing effective practice protocols, support and training to sonographers and assistants. Relevant literature was obtained following a systematic literature search. Three studies were reviewed with cohorts ranging from 10 to 92 sonographers. All studies asked sonographers how they felt about breaking bad news, the support they felt they had and the training received in relation to breaking bad news. Arezina highlighted that training methods used most commonly were the least preferred and vice versa.[1] Thomas et al. indicated that inconsistent protocols had a negative impact and highlighted potential stressors such as lack of prior knowledge of the patient, risk of complaint, feelings of guilt.[2] Simpson et al. suggested that formal training on counselling skills would increase the sonographers' confidence and if they could recognise their own psychosocial needs, they would be better equipped to recognise the needs of others.[3] Simpson et al.[3] also highlighted that 'bad' news has a different meaning for everyone. In the three studies there are common themes: inconsistency in practice protocols (if available); lack of formalised training; lack of support; frustration and stress. The NBCP provides a framework for supporting sonographers and assistants, which will lead to an overall improvement in patient and staff experience of pregnancy loss.

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Case report: Placental mesenchymal dysplasia

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Abstract

Placental mesenchymal dysplasia (PMD) is a rare, benign condition that is characterised by enlargement of the placenta with multiple bunch of grape-like vesicles that can resemble a molar pregnancy by ultrasound and gross pathologic examination.[1] A 29-year-old female (Gravida 3 Para 1) presented for a routine dating scan at 12 weeks 6 days' gestation. A single live foetus was seen and also an enlarged cystic placenta. This was reported as a possible partial molar pregnancy with a live coexisting foetus. Following the scan, a referral was made to the Trust's Early Pregnancy Unit (EPU). She was seen the following day and a subsequent referral was made to the Tertiary Referral Centre. The anomaly scan was performed at 20 weeks 1 day' gestation and again the cystic placenta was noted. During the pregnancy there were multiple admittances for PV bleeding and reduced fetal movements; subsequent antenatal care was taken over by the Tertiary Referral Centre. At 32 weeks 5 days' gestation, a live male foetus was delivered by elective Caesarean section. He was admitted to the neonatal unit following delivery. The patient underwent a total hysterectomy immediately following delivery due to massive post-partum haemorrhage and was admitted to the Intensive Care Unit. Histopathology of the placenta described a 'pathologically large (1613 g) preterm placenta with mesenchymal dysplasia and secondary chronic foetal malperfusion'. PMD is a rare disorder that is estimated to occur in 0.02% of pregnancies.[2] 'It is probably under-diagnosed as it is an unfamiliar clinical entity and also mistaken for gestational trophoblastic disease because of similar sonographic findings of the two entities'.[3] However, 'Unlike molar PMD, it co-exists with viable foetuses'.[4]

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Paediatrics

Paediatric thyroid lesions

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Abstract

Ultrasound evaluation plays an integral part in the diagnosis and subsequent management of thyroid lesions in children. Paediatric thyroid scanning can be a daunting prospect. This poster provides a pictorial review of the ultrasound appearances of common paediatric thyroid lesions and their diagnostic features. The spectrum of paediatric thyroid lesions is wide. Broadly, they can be split into acquired and congenital causes of disease. An understanding of the embryogenesis, anatomy and function of the thyroid gland is important for accurate diagnosis. Acquired paediatric thyroid lesions arise following completed thyroid development. They differ from those encountered in the adult population in several ways. They are relatively rare, affecting 1%–2% of this population, and the risk of thyroid cancer is significantly higher than in adults. Cases to be presented include papillary cancers, intermediate lesions and thyroiditis. Certain ultrasound features and patterns can lead to confident categorisation into a benign or malignant process. An intermediate group with both benign and malignant characteristics also exists and it is important to identify these as they will require further investigation and assessment. Congenital paediatric thyroid lesions arise from anomalous thyroid development. Cases to be presented include thyroglossal cysts. They are the most common congenital cystic neck mass, and arise from failure of thyroglossal duct involution during foetal development. They can be associated

with ectopic thyroid tissue and have characteristic ultrasound appearances. Accurate and timely assessment of the paediatric thyroid lesion is essential for safe and effective management. This poster aims to build the confidence of those performing paediatric thyroid ultrasound using case-based examples.

Ultrasound assessment of the groin in children

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Abstract
The dynamic, real time capabilities of ultrasound are particularly useful in evaluation of the groin region. Our DGH department is receiving an increasing number of requests from paediatricians, ED and GPs for US of the groin, with three main categories of referral: a palpable swelling or lump in groin or scrotum; to answer a specific question in relation to an episode of MSK trauma; to attempt to establish a cause in a child presenting with a limp or non-specific pain. Although scan technique for the groin is similar in adults and children, the anatomy of the joints and cartilaginous enthyses may be unfamiliar and changes over a relatively short period of time as the cartilage progressively ossifies. Congenital and developmental lesions such as patent processus, undescended or malpositioned testes are more likely to be encountered. Young children may not accurately localise or communicate the site of their symptoms, requiring a greater flexibility of approach. Our pictorial discussion describes the approach used in our department, focusing on anatomy, probe position and ultrasound technique and how to vary the examination according to the indication in order to examine the hip joint, musculo-tendinous attachments, hernial orifices or palpable lumps. We show normal anatomy and avulsion injuries, discuss Valsalva techniques and various types of groin hernia and inguinoscrotal developmental abnormalities and how to distinguish them. We include some of the wide spectrum of groin lumps and bumps encountered in a DGH setting. Ultrasound is excellent for the examination of the groin in children. Scan technique can often be tailored to the specific question being asked, but with young children presenting with non-specific symptoms a more structured approach may be required.

Ultrasound of ambiguous genitalia: Challenges and pitfalls

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Abstract
An ultrasound scan is an essential imaging tool in the initial assessment of an infant or child presenting with ambiguous genitalia.[1] Within this poster presentation the authors explore the background to the many different and complex appearances arising from this condition. Case studies illustrate the varied ultrasound findings encountered in the spectrum of disorders of sex development (DSD) with genetic correlation, which is an essential component of the patient pathway for gender assignment. Sometimes the appearances are confusing and may mean that a follow-up scan or further imaging is needed, delaying diagnosis and decision making. A multidisciplinary team approach is vital to ensure that the family understand the limitations of the ultrasound and that anatomical presence does not indicate normal function.

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Making use of the mastoid fontanelle: Additional views in neonatal intracranial ultrasound imaging

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Abstract
Ultrasound is widely used for examination of the brain in neonates. It has particular value for screening and follow-up in those at high risk of intracerebral haemorrhage, for detection of ischaemic or haemorrhagic brain injury as well detection of structural abnormalities or conditions such as hydrocephalus. Routine intracranial ultrasound examination takes advantage of the anterior fontanelle prior to its ossification at around 6–9 months of age in normality. Sagittal and coronal images from this acoustic window are usually obtained, however, views of the infratentorial posterior fossa structures such as the

cerebellum may be limited. Thus alternative acoustic windows such as the posterior fontanelle or mastoid fontanelle may need to be used. This poster focuses on the use of the mastoid fontanelle, which has particular value in detecting haemorrhage involving the cerebellum, brainstem and subarachnoid cisterns. Views through the mastoid fontanelle are not universally obtained as part of a standard examination and this poster aims to highlight particular benefits of incorporating this approach, describe good sonographic technique, demonstrate anatomical structures which may be appreciated on a normal study and introduce common or important pathological appearances where this approach has been utilized.

Ultrasound diagnosis of neonatal intra-abdominal cysts: An educational pictorial essay

ELH Teo
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Abstract
An ultrasound is the modality of choice to confirm and further characterize an antenatally detected cyst during the post-natal period. Common differential diagnoses include multicystic-dysplastic kidneys, hydronephrotic kidneys, ovarian cysts, mesenteric cysts, enteric-duplication cysts, meconium pseudocysts, lymphangiomas and less frequently, cystic neuroblastomas, adrenal haemorrhage, liver haemangioendotheliomas and teratomas. In many cases ultrasound is able to specifically diagnose the cyst based on its location and imaging characteristics. Plain radiographs, CT and MRI may be needed in some cases to further characterize these lesions should ultrasound not be able to diagnose the lesion. The objectives of this educational pictorial essay are: first to highlight the ultrasound spectrum of intra-abdominal neonatal cysts; second to show how the further use of other imaging modalities is able to help the radiologist further characterize these cysts and to provide a specific or narrower differential diagnosis; third to show how patient care is improved by guiding the next appropriate step in management. Correlative surgical and pathological images are shown where available. After reviewing this poster, the reader should be familiar with the imaging features of the different intra-abdominal cysts in the neonate and how to accurately diagnose many of these lesions on ultrasound.

Ultrasound of the inguinal canal in children: A pictorial essay

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Abstract
The objectives of this essay are to illustrate the anatomy of the inguinal canal on ultrasound and to familiarize the reader with pathologies that may be encountered in the paediatric inguinal canal. The inguinal canal is a passage that extends inferiorly and medially through the inferior part of the abdominal wall. The spermatic cord in males and the round ligament in females pass through the canal. The patent processus vaginalis (PV) is an embryonic developmental outpouching of the peritoneum that passes through the inguinal canal and usually closes by two months of age. Failure of closure results in an abnormal communication between the peritoneal cavity and the scrotum in males, and the labia majora in females. This may result in a number of conditions whose imaging findings will be shown in this poster. A patent processus vaginalis in females is known as the Canal of Nuck. This poster illustrates the anatomy of the inguinal canal. The ultrasound findings of a wide range of pathologies such as inguinal hernias containing incarcerated bowel, omentum, ovaries, uterus, the appendix and Meckel's diverticulum, as well as pathologies such as testicular torsion, cryptorchidism and hydrocoeles-communicating and non-communicating .are be shown. After reviewing this poster the reader will be familiar with the ultrasound anatomy of the inguinal canal and as well as the imaging findings of pathologies that may occur within it.

The use of contrast-enhanced ultrasound in the identification of paediatric blunt abdominal trauma

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Abstract
Uncertainties still surround the use of contrast-enhanced ultrasound (CEUS) in the paediatric population and its ability to evaluate blunt abdominal trauma injury. The purpose of this research was to systematically review the evidence regarding the accuracy and safety of CEUS in the paediatric population who have sustained blunt abdominal trauma.

All relevant studies from 2001 onwards which investigated the use of CEUS in the paediatric population, in relation to blunt abdominal trauma evaluation, were systematically reviewed. Five studies fulfilled the inclusion criteria. The main finding was that CEUS was demonstrated to be a highly accurate imaging modality for the identification of abdominal trauma in the paediatric population. Studies show that it is particularly useful in detecting laceration, haematoma and active bleeding but less sensitive in the detection and characterisation of urinomas following renal injury. Limitations were noted in the methodological quality of the included studies, which included small populations and limited areas of investigation. The use of CEUS in the paediatric trauma management pathway is promising with sensitivity and specificity to match computed tomography (CT) in the detection of certain traumatic pathologies. However, its use has been hindered by its off-label legislation meaning there is a lack of high-quality studies in this field. Further large scale primary studies are required in order to evaluate its use in the paediatric population.

Case report: Coarctation diagnosis from renal ultrasound

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Abstract
An inpatient was referred to ultrasound from the paediatric consultant, regarding hypertension in a young female patient. The clinical question was for any evidence suggesting possible renal artery stenosis that may account for the patient's symptoms. There was no mention of any other underlying pathologies. These are not always well demonstrated on ultrasound for numerous reasons, such as bowel gas, two renal arteries, patient body habitus etc. I scanned the patient as normal assessing renal size and outline. I managed to demonstrate good perfusion on colour Doppler. However, the renal arteries showed unusual dampened waveforms bilaterally. In light of the fact that the kidneys appeared otherwise normal it was doubtful that this would represent bilateral renal artery stenosis in a young patient. I decided to look at the femoral arteries, which also demonstrated an unusual dampened waveform. I further assessed the radial arteries bilaterally to see if there were any proximal changes. These demonstrated normal waveforms. I was concerned at this point and discussed the findings with a consultant vascular radiologist, who suggested this may represent a proximal aortic problem, either coarctation or possible proximal aortic narrowing. The patient went on to have a chest X-ray which showed features of possible aortic coarctation; the reversed 3 sign and subtle rib notching. The patient was referred to a specialist centre for further cardiac assessment, where they confirmed severe aortic coarctation with small transverse arch and LV hypertrophy.

Physics

Use of the Leicester Elastography Pipe phantom for assessing performance of ultrasound shear wave elastography: An inter-/intra-observer reproducibility study

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Abstract
Shear wave elastography is emerging as a valuable imaging modality to quantify Young's modulus (YM) of various tissues. Test objects are required to assess performance of this new technology and for routine quality assurance. Analogous to the Edinburgh Pipe Phantom, which quantifies performance of grey-scale imaging, the Leicester Elastography Pipe Phantom (LEPP) was developed to assess elastography imaging performance. The aim of this study was to assess the potential value of LEPP as a test object and reproducibility of LEPP measurements within and between observers. The LEPP consisted of five soft PVA-cryogel pipes with varying diameters (2 mm–12 mm), surrounded by a stiffer agar-based tissue mimicking material (TMM). A Supersonic Aixplorer ultrasound system with L15-4 probe was used to image longitudinal sections of each pipe at different depths and scanner settings. The penetration depth and YM measurements within each pipe were obtained by two observers to assess reproducibility. Inter- and intra-observer reproducibility of the penetration depth measurements was excellent (intra-class correlation coefficients ICC $=>0.80$ in all pipes). The penetration depth increased with increasing pipe diameter and use of 'penetration' setting (depths 5.3, 4.6 and 4.5 for 12 mm pipe compared to 3.9, 2.9 and 3 cm for the 2 mm pipe for the penetration, resolution, and standard settings, respectively). The YM estimates within the 2 mm region of

interest placed in the middle of pipes decreased with increasing depth and were lower for 4 and 2 mm pipes (approx. range 130–40 kPa). The LEPP provides quantitative information about SWE imaging performance. Inter- and intra-observer reproducibility is excellent. Use of the LEPP helps establish optimum scanner settings and assess artefacts and errors in YM estimates due to partial volume effect, signal to noise and depth.

Low-intensity pulsed ultrasound for bone regeneration therapy: A controlled in vitro study method

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Abstract

Low-intensity pulsed ultrasound (LIPUS) stimulates healing of fractured bone. Many in vitro studies, including Tang et al.,[1] have investigated the mechanisms involved by measuring cellular markers of bone regrowth under various acoustic conditions, but comparison between trials is difficult due to inadequate acoustic characterisation. Many set-ups are prone to standing waves and plate resonances, making acoustic conditions difficult to predict. Additionally, spatial-average acoustic intensity (ISATA) is the standard measure of exposure, whereas mechanical bioeffects, considered the most likely mechanism, are more associated with peak-negative pressure (PNP). This study aims to establish a robust and repeatable protocol for in vitro investigation of LIPUS and proposes the use of PNP to compare results. Murine osteoblast cells (MC3T3-E1) were grown to confluency in a custom cell-holder, comprising a circular 3D-printed frame (VeroGrayTM) bounded by 6 μm Mylar membranes (Goodfellow, UK), providing an acoustically transparent window and cell growth surface. Self-sealing septa allow injection of cells and growth media. The cell-holder was positioned 100 mm from a purpose-built LIPUS transducer in a tank of sterilised water at 37°C and exposed for 20 minutes to LIPUS with frequency 1 MHz, pulse width 200 μs, repetition rate 1 kHz, PNP 0 kPa (control) to 500 kPa. The maximum and spatial-averaged PNPs and Intensities were determined prior to exposure by scanning with a 0.5 mm needle hydrophone (Precision Acoustics, UK) and correcting for membrane attenuation. After incubating for 24 hours, the concentration of Prostaglandin E2 (PGE2), a marker of bone regrowth used by Tang et al.,[1] was measured using an ELISA kit (Abcam AB133021) and standard microplate reader (Tecan, AT). PGE2 up-regulation was assessed against PNP to establish optimal conditions for LIPUS stimulation of bone regrowth. Intensity data allowed comparison with existing studies. The results will validate the protocol for controlled investigation of the mechanisms involved in LIPUS stimulation.

Reference

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A novel complex flow phantom for Doppler ultrasound

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Abstract

Traditional Doppler ultrasound methods and newer ultrasound technologies, including vector flow imaging and volume quantification, are used to measure blood flow in cardiovascular systems exhibiting complexities such as recirculation, turbulence, jets and vortices. Existing Doppler phantoms struggle to confirm the accuracy of ultrasound methods in measuring complex flow. A novel phantom, designed to produce complex flows that are physiologically relevant, stable, predictable, controllable and reproducible, is presented. A Vortex ring is chosen as the reference flow for the development of the proposed phantom. A vortex ring forms when a column of fluid is pushed through a smaller orifice into a neighbouring fluid environment. The fluid 'rolls up' at the orifice face, forming a toroidal vortex that (for specific Reynolds numbers) propagates along its axisymmetric axis. The phantom design proposed uses a piston/cylinder system to propel a slug of fluid through an orifice that connects to an open tank full of fluid. Different orifices diameters can be provided on demand. Main vortex parameters, which are related to the piston displacement and piston speed, can be controlled by a programmable microcontroller and a linear stepper motor. Orgasol® particles (10 μm) were chosen to provide a scattering signal for vortex visualisation using ultrasound. Laser-PIV (particle image velocimetry) measurements have

shown that vortex ring velocities ranging from 8 cm/s to 80 cm/s can be produced with reproducibility better than ±0.8. We demonstrate an ultrasound scan of the ring vortex with examples of B-mode and Colour Flow Doppler images and Pulse Wave Doppler spectrum. A novel, cost-effective, vortex ring flow phantom has been presented. Early results point to its potential as an ultrasound flow phantom that can test scanners operating in standard Doppler modes and advanced flow mapping modes.

Professional Issues

Advanced practice in ultrasound: Extending the boundaries

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Abstract
Ultrasound advanced practice has allowed development within specialist areas. Within a large teaching hospital, ultrasound advanced practitioners have developed into leading clinical roles which include the use of interventional techniques to aid with clinical diagnosis. This poster demonstrates the extended roles that ultrasound advanced practitioners have within the specialist areas of head/neck and musculoskeletal ultrasound which have only been previously performed by consultant radiologists. The ultrasound advanced practitioners involved have been through a rigorous training programme, which includes assessment by consultant radiologists, which enable them to independently perform several interventional procedures under ultrasound guidance. These techniques include fine needle aspiration of neck and thyroid cancers and small joint injections of the hand and wrist. The poster demonstrates the training programmes, the procedures performed and the autonomy that the advanced practitioners show during the lists that they perform. The poster demonstrates how guidelines and policies have been produced to allow this to be performed safely and at a high standard. Ultrasound advanced practitioners are able to perform autonomous ultrasound guided interventional procedures to the same high level as a consultant radiologist, thus pushing the boundaries of advanced practice.

BSc(hons) medical ultrasound

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Abstract
It is universally accepted that the ultrasound profession is becoming ever more diverse. As such a broad spectrum of healthcare professions are choosing to adopt and embrace the use of ultrasound technology to create a competitive advantage within their respective fields. It must also be noted that alongside an exponential increase in the clinical requirement of CASE trained sonographers and service needs, the ever-varying needs of the patients must also be addressed. It is accepted that a significant overhaul to the traditional postgraduate intake route must be implemented, failure to do so resulting in the above aspirations not being delivered upon. For those individuals wishing to pursue a profession in sonography, there are a number of defined pathways available, namely, post-graduate study and short stand-alone ultrasound courses (Focused Courses). In order to address the education shortfalls and provide a greater volume of skilled students, there must be focused effort by the education bodies to provide a wider and more varied pathway, without depleting other struggling professions such us radiography, midwifery, nursing or physiotherapy. The introduction of the innovative new direct entry course will ensure that a new generation of professionals are both attracted to the profession and set on a structured education pathway, resulting in a diverse workforce needed to address the constraints present in today's system. This poster presents the contents of the Direct Entry BSc (Hons) Medical Ultrasound plus PgCert Medical Ultrasound (perceptorship) programme.

Direct entry: The University of Cumbria experience

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Abstract
In 2016, the University of Cumbria introduced the UK's first dedicated Direct Entry Postgraduate Ultrasound MSc and following a careful selection process accepted five students on to the programme with the support of five clinical ultrasound departments who agreed to be placement hospitals.

This report investigates findings arising from interviews with the clinical leads of these placement hospitals as well as the first cohort of students, evaluating their experiences and opinions of the programme throughout the two-year registration period.

The use of normal pregnant volunteers in ultrasound education – First insights of student experience

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Abstract
The use of normal volunteers has been well utilised in ultrasound education. This has been restricted to non-pregnant volunteers in accordance with BMUS guidelines on the use of volunteers for teaching purposes. Guidelines and governance procedures for the use of normal pregnant volunteers have been produced by the academic team at the University of Derby in conjunction with the obstetric clinical team at University Hospitals of Derby and Burton NHS Foundation Trust and in consultation with the BMUS safety group. Pregnant patient volunteers recruited from the local Obstetric Ultrasound Department at the Royal Derby Hospital were utilised during the Obstetric module academic teaching on the university campus to enhance and embed practical learning within the academic practice. Student feedback obtained during the first academic uses of pregnant volunteers is discussed to provide insight into how this has enhanced their learning experience.

Surviving Big Brother – Maintaining quality without damaging staff moral

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Abstract
No one likes scrutiny, no one wants to be watched. What if we are found wanting and outside of the norm? But, a robust, well established peer review system can do just that. As dedicated health care professionals we strive to deliver the best care we can, but with growing experience can come complacency and a false-belief that you can learn no more. As has been documented in previous studies, there is no optimum method to fully review sonographers practice. The best tool available at this time is the BMUS recommended audit tool. Regular peer review of static images in conjunction with monthly learning from discrepancy meetings (LDMs) have been well established within this institution since 2013. The sonographer discrepancy rate within the department is known. The LDMs have provided significant opportunity for learning and education programmes but require engagement from all staff. In the ideal world all sonographers would embrace such an opportunity to have their work reviewed and scrutinised but the reality, we know, is different. It can be a scary and off-putting process which unfortunately can lead to disenfranchising our valued sonographers. This poster presents the darker side of peer review. What does the process actually feel like? How did we get full engagement from the staff involved and how did they survive big brother?

Empathy scores following an interactive service user session for sonography students: A pilot study

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Abstract
Empathy and compassion are deemed to be important skills needed for working in the healthcare setting. Sonographers are expected to deliver difficult news to patients, often under challenging circumstances, without warning and in some cases when unsure of the actual diagnosis. This study aims to assess medical ultrasound students' opinions of a new interactive service user and carers session, which was introduced to the programme in June 2017. It also investigated whether empathy scores changed in response to the interaction with service users. Students were invited to participate in the study by completing the Toronto Empathy Questionnaire before and after the service user session.[1] Students and service users also completed a short questionnaire at the end of the session, for evaluation and to provide suggestions for future iterations. Students were asked to reflect on what they had learnt and how it might impact on their practice. Twenty three students (48%) participated in the study at a single institution across two cohorts. Twenty empathy scores were valid. In the first cohort, average empathy scores increased from 48.1 to 51.9 with 80% of students showing increased empathy score, whereas the second cohort average empathy scores remained the same pre- and post-session at 51.3, with 40% increasing, 40% reducing and 20%

remaining the same after the session, (published norms 44.5–47). The event met or exceeded students' expectations, despite one student thinking they would not 'get anything out of it'. Students valued the 'candid and frank' exchange with service users. Empathy levels increased or remained the same three quarters of students. Various ways to change practice in light of this session, which would impact on patient care and communication, were highlighted.

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Service needs, capacity and innovations to extend clinical capacity for sonographer education: An online survey

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Abstract

Sonography is a shortage occupation, with evidence suggesting vacancy rates of between 5 and 25% in England. Ultrasound education is changing to meet service needs; however, one challenge being faced by education providers and clinical staff is the lack of clinical placement capacity. An online survey was sent to ultrasound managers to investigate innovations being used to increase clinical capacity for educating sonographers. Higher education providers were also contacted via email and telephone for their views on innovations in ultrasound clinical education. Additional objectives of the study included determining current and future estimated sonographer shortages and placement capacity. There were 72 responses to the questionnaire. The average shortfall in sonographers was 2.65, with 5% of departments reporting a deficit of 10 sonographers. The predicted number of additional sonographers required to provide the service in five years' time was an average of 4.6 sonographers, with 10% of departments anticipating they will need an additional 10 sonographers. Most departments were involved in clinical ultrasound education, with 51% of students being sonographers, averaging two per department. Several departments had additional capacity for teaching students, with a combined total of 45 places. A number of challenges were raised by respondents, particularly relating to issues of funding for student sonographers, balancing clinical and teaching requirements, staff shortages and the need to teach others, e.g. radiologists because of radiology shortages. A number of different methods are being used to extend the capacity for clinical education of sonographers; these include extended working days and weekend teaching lists, simulation and peripatetic clinical educators. As ultrasound education is undergoing changes, to meet the increasing service needs, innovative solutions to increase placement capacity are needed. This study provides some ideas to assist education providers, clinical departments and stakeholders to meet these demands

Implementing a multi-disciplinary service for new-born hip screening

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Abstract

The neonatal new-born screening service for development dysplasia (DDH) of the hip was previously provided by the neonatology team within our institution. They were unable to continue to provide this service and the ultrasound department agreed to provide this service in conjunction with the orthopaedic and paediatric physiotherapy department. The model chosen to implement this new service change was the Plan, Do, Study, Act (PDSA) cycle. This poster describes how a multi-disciplinary whole team approach working under the PDSA framework enabled a model service to be implemented within a short space of time (three months). Continual evaluation of the service is essential and a second PDSA cycle has been instigated to 'fine-tune' the service and resolve any additional issues which were not anticipated at the start of the project. It is hoped that our own experiences described in this poster will be of benefit to others when they are looking to implement new services, service improvements or simply looking to evaluate their existing services. We will stress the benefit of a whole team approach, working collaboratively across the

multi-disciplinary team towards a common aim. The use of the PDSA framework has also been invaluable in helping to deliver an optimal service within the necessary time frame.

Sonographers' experiences of work-related musculoskeletal disorder: The everyday consequences of physiological stress and injury in contemporary ultrasound

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Abstract

By 2013, the UK government's Migration Advisory Committee had listed sonography as an official 'shortage specialty'.[1,2] As a consequence of the working stresses allied to this shortage, British sonographers have increasingly been reducing hours or leaving clinical practice entirely.[3] Moreover, among those who remain, incidences of reported chronic pain and active injury are also on the increase within a profession that was already synonymous with high rates of work-related musculoskeletal disorder (WRMsD).[4] While contemporary research has described the rates of WRMSD among ultrasound practitioners,[5] none has to date extensively explored its personal and professional impacts. Using a model of Interpretative Phenomenological Analysis with proven facility in medical imaging research,[6] extended semi-structured interviews with N = 10 experienced sonographers were analysed. Participants routinely reported a sensation of guilt and depleted self-efficacy that not only permeated any working absence resultant of their own WRMSD, but also to taking legitimate leave when colleagues were suffering from WRMSD. An upshot of this was to recurrently 'take one for the team' and work through excessive pain, even when this would likely result in greater prospective physical damage. While the basic shortage of sonographers was the core attribution for such behaviours, participants also cited: (1) increasingly obese patients; (2) increasingly unhelpful (i.e. profiteering) equipment manufacturers; (3) their own paternalism regarding healthcare. The present situation in ultrasound mirrors a culture of potentially dangerous pain acceptance that been noted in the psychology of sport for some time,[7] albeit for altruistic, rather than egotistic, reasons.

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Vascular

Case report: Doppler ultrasound in the surveillance of a femoro-popliteal bypass graft and associated pseudoaneurysm

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Abstract

Bypass graft pseudoaneurysm are a delayed complication of surgery, usually located at anastomosis level. This case study demonstrates the role of Doppler ultrasound in the surveillance of a left femoro-popliteal autologous vein bypass graft, with subsequent pseudoaneurysm formation at mid graft level. Seven years after initial surgery, Doppler ultrasound demonstrated a 3 cm × 3 cm pseudoaneurysm arising from the mid portion of the graft. Nine months later, the patient returned for further imaging. Doppler ultrasound revealed that the pseudoaneurysm had increased in size to 4.7 cm in maximal dimension. Consequently, the patient underwent surgery to excise the pseudoaneurysm. Ten days later, Doppler ultrasound was again performed due to a swelling in the patients mid-thigh. This corresponded to a 4.7 cm × 5.7 cm hypoechoic avascular abnormality surrounding the bypass graft, consistent with a haematoma. Peripheral arterial disease is an increasing entity worldwide and advanced disease

results in a decline in ambulatory functions and reduced quality of life. In the management of the disease, revascularisation of the limb plays a critical role. In the post-operative setting, a successful Doppler ultrasound graft surveillance program will prolong graft patency, an example of which includes a Doppler ultrasound at 1, 3, 6 and 12 months and 6 months thereafter. Unfortunately for the patient at the centre of this case study, a CT angiogram two months post-surgery revealed an occluded femoro-popliteal bypass graft throughout its length. Subsequently, the femoro-popliteal bypass graft was revised with a synthetic interposition graft. Doppler ultrasound plays an essential role in both the surveillance of femoro-popliteal autologous vein bypass grafts and identification of subsequent complications. As a result, a Doppler ultrasound surveillance program should be implemented for all patients undergoing femoro-popliteal bypass surgery.

Learning from experience and sharing knowledge: Doppler training for nurses to improve pedal pulse assessments

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Abstract

Transcatheter aortic valve implantation (TAVI) requires a puncture to be made in the femoral artery. Post-procedure patients are monitored on the ward for complications which involves assessment of the pedal arteries. Following a clinical incident where a patient suffered an occlusion, practice in our trust has recently changed so that pedal pulses are assessed by Doppler rather than manual palpation. To ensure the accurate use of Doppler by nursing staff, the Vascular Science Department was contacted to request training and assessment. The aim of the training was to enable cardiac nursing staff to accurately assess pedal pulses with Doppler. This included the ability to: locate three pedal arteries; apply an accurate technique of probe positioning to interrogate the pedal arteries; recognise the Doppler pulse sound as either healthy or abnormal. A training plan and competency assessment were developed by a clinical vascular scientist. An explanation and demonstration of technique was provided by the scientist allowing one-to-one training sessions. Nursing staff were provided with a competency log to document their learning. To achieve a certificate of competency, a satisfactory technique and thorough understanding of the test without assistance must be demonstrated. Between March and July 2018, 17 nurses received one-to-one training and are currently completing their competency logs. The training is ongoing with the remaining eight nurses scheduled to have training in the coming weeks. Although most nurses were confident in their Doppler technique prior to training, on reflection they recognised they were unaware of the correct location of the pedal arteries and unaware of the importance of probe angle positioning. Nurses have been trained to recognise differences in healthy and abnormal Doppler signals. This allows them to identify a potential reduction of blood flow to the foot at an earlier stage than occlusion, therefore prompting earlier medical attention in the aim to prevent major complications.

Case report: Put your thinking HAT on – Pulsed-Wave Doppler ultrasound characteristics of a hepatic artery thrombosis

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Abstract

This case study describes the ultrasound findings of a 54-year-old female who presented to the ultrasound department with raised liver enzymes, eight weeks post-orthotopic liver transplant (OLT). The immediate post-operative 'Ducts and Doppler' ultrasound examination showed no evidence of vascular complications and her recovery was uneventful. Upon presentation eight weeks later, the ultrasound examination demonstrated a late post-procedural hepatic artery thrombosis (HAT). Doppler ultrasound imaging demonstrated an extra-hepatic artery with areas of aliased colour filling tapering to an area void of colour filling. A 'tardus-parvus' waveform was detected in the intra-hepatic segment of the common hepatic artery and right intra-hepatic artery. Left hepatic arterial flow was absent. Arterial resistive index (RI) and systolic acceleration time (SAT) were both indicative of an occlusion ($RI > 0.5$, $SAT > 0.08$ seconds, classic tardus-parvus waveform, absent flow of the left hepatic artery). Furthermore, a collateral arterial supply to the RHA was detected. CT corroboration imaging showed a stable hepatic artery thrombosis with a small intra-hepatic collateral arterial branch formation. Ultrasound is utilised as the first-line imaging modality when assessing liver vascularity post-OLT.

Spectral and colour Doppler ultrasound have a crucial role in the diagnosis of HAT. In this case, an arterial complication was ultrasonically diagnosed due to an aliasing common hepatic artery tapering to an area void of colour flow. Downstream, spectral Doppler demonstrated a 'tardus-parvus' waveform. The left hepatic artery demonstrated no flow. Doppler ultrasound has both a high sensitivity (54% to 92%) and specificity (64% to 88%) in the diagnosis of HAT. Correct operator technique is crucial for accurate measurements and every.